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BRIEFLY TOLD.

BUT THE GAS DID NOT GO.—The government authorities have, because of the results of experiments conducted by them with a view to determining its efficiency, been greatly in favor of the Lungren lamp, and many notable installations of the same are now to be seen in the public buildings throughout the country. Naturally such use is at once reassuring to the gas maker and flatteringly profitable to the makers of the burner. From all that we had heard of its use by the government, the conclusions derivable were that in every sense it had been found satisfactory, and that its extended application to the lighting of government buildings' interiors was assured. Some time ago, however, we were very much surprised at reading the following item in the pages of the *Electrical Review:*

"*A Point in the Electricity-Gas Conflict.*—A small point in the electricity-gas conflict has been developed by the government's use of the Lungren gas burner, which is commonly placed in the center of and beneath the branches of a fixture which support the electric lamps. Some of the incandescent electric companies have contended that the excessive heat radiated by these large gas burners would destroy the insulation of the fixtures' wires, and therefore 'gas must go.' Some of the government offices find the Lungren burners very useful."

It will be noted that while the *Electrical Review* presentation of the case does not commit that authority to an espousal of the claim of "some of the incandescent electric companies," in respect to the danger of the radiated heat from the Lungren lamp seriously affecting the insulation of the electric current-carriers, it is nevertheless a fact that the *Review* does not make any positive denial of the absurd suspicion put forth by the incandescent companies—although it does admit that "some of the government offices find the Lungren burners very useful." Desiring to obtain an authoritative denial of the assertion that the aforesaid use of Lungren lamps could in any manner affect the delivery of incandescent lighting currents, we placed ourselves in communication with Mr. E. Stein, President of the Siemens-Lungren Company, who promptly responded in the following manner:

THE SIEMENS-LUNGREN COMPANY,
Philadelphia, Pa., Dec. 9, 1889.

To the Editor AMERICAN GAS LIGHT JOURNAL:

Referring to the assertion made by some of the incandescent electric lighting companies that the heat generated by the Lungren lamp would destroy the insulation of the fixture wires, we desire to say that, by direction of the Treasury Department, thorough tests were made to determine this point before the decision was arrived at to adopt the Lungren lamp as a part of the combination fixture. The results of these tests were such as to successfully establish the fact that the insulation was not injuriously affected. We have copies of the official report to that effect. We are receiving many orders from the Treasury Department for Lungren lamps for use in combination fixtures, having incandescent lamps for the side lights; and these are being largely employed in the mailing rooms and other places where large volumes of light are required—principally in the post offices throughout the country. Further, in many instances the Lungren lamp is used alone (without the incandescent lamp being turned on) where such combination fixtures form the lighting equipment. Perhaps this has given rise to the report of which you speak; but it is the fact that such omission to use the incandescent lamps on the fixture is owing to the superior quality and ample volume of light obtained from the Lungren lamps, and not because of any injury done to the electric light wire by the latter. In other words, the Lungren lamp alone amply met the illuminating necessities of the situations where the combination fixture had been installed.

Very truly, E. STEIN, Pres.

In view of this explanation it is only the hardened electric enthusiast who will gainsay the *Electrical Review's* admission that even "some of the government offices find the Lungren burners very useful."

PHOTOGRAPHING BY THE AID OF THE WELSBACH LIGHT.—We beg to acknowledge the receipt from the Welsbach Incandescent Gas Light Company, of Philadelphia, copies of individual photographs that were taken during the progress of the last meeting of the American Gas Light

Association, the Welsbach incandescent gas burner being the vehicle that illuminated the temporary photographing room. The photographer was the well-known Mr. Geo. G. Rockwood, of Union Square, New York, and the specimens of his Baltimore Welsbach photographing are as perfect and complete as anything ever developed by him in the ordinary method at his Union Square parlors. In fact we heartily congratulate the Welsbach Company on the complete success that attended its object in making the display, which, to use the Company's own words, "was to show to our friends in the gas business a new use to which illuminating gas can be put."

To Try the Value of Boston's Public Arc Lights.—Alderman Barry, at a recent meeting of the Boston Council, offered a resolution ordering the appointment of a special committee to be charged with the duty of investigating as to whether or not the contract between the city and the Boston Electric Light Company is being carried out by the latter in accordance with the conditions of the agreement. In arguing in support of the resolution, Mr. Barry bluntly asserted that he believed that while the city was paying for lights of 2,000-candle power, it was being served with only 1,200-candle power. This view was shared in by other members of the Board, and the outcome was that the investigation was determined upon. This resolution and action are timely, in that the city is now about to enter into a new contract for the electric lighting, with every probability that the Boston Electric Light Company will again receive the lion's share of the award. It may be different, however, if the investigating committee finds that much of the Company's past service was founded on a supply much below the value agreed upon in the contract.

Gas v. Electricity for the Public Lighting of Paris.

The London *Journal* says that it will doubtless be in the recollection of its readers that early in the present year the Paris Municipality decided, with the view of adding to the attractions of the city during the period of the exhibition, to illuminate some of the principal boulevards by the electric light, and then adds: The portions selected were, of course, those which are always most frequented—viz., the boulevards forming a continuous line westward from the Porte St. Martin to the Madeleine—a distance of rather more than a mile and a half; and in order to give a good "finish" to the scheme, the Rue Royale (which is a kind of connecting link between the western end of the boulevards and the Place de la Concorde) was included. In due course, the lamps were put up; the position determined upon being the center of the roadway. They were all arc lights, placed on ornamental posts considerably higher than those used in ordinary street lighting. In view of the decision of the Municipality, the Paris Gas Company applied for, and were granted permission to show what could be done in the way of public lighting by means of improved gas lamps and burners. The places selected by them for their demonstration were the Rue de la Paix and the Avenue de l'Opéra—two fine streets running at angles from the Place de l'Opéra, on the line of boulevards already referred to, southward towards the Seine. The avenue, it may be remembered, was the scene of the earliest electric street lighting experiment in Paris, one result of which was to rouse the Paris Gas Company to light the adjacent Rue du Quartre Septembre with a new high-power burner to which they gave the name of the street. The area lighted by the Company in the Rue de la Paix is 5,152 square meters (1 square meter = 1.2 square yards); and there are employed for the purpose 117 burners of the "Parisien" type, giving the light of 6 Carcels, or 57 candles, taking the Carcel as equal to 9.5 candles, with a consumption of 350 liters, or about 12.5 cubic feet of gas. These burners have taken the place of a similar number, giving the light of 1.1 Carcels, with a consumption of 140 liters of gas. The total quantity of gas consumed by the new burners is about 2½ times as much as was burnt before; but the amount of light yielded is 5½ times greater—being 0.138 Carcel, as compared with 0.025 Carcel, per square meter of surface. In the Avenue de l'Opera the superficial area illuminated is altogether 20,940 square meters, for which there are employed 189 "Guibout" burners, each of them giving the light of 11 Carcels with a consumption of 550 liters of gas, and seven burners of higher power, each yielding 27 Carcels with 1,200 liters. The 189 burners replace a similar number of ordinary 5-feet burners; and the seven of higher power are in substitution of burners which, with a consumption of 1,400 liters of gas, gave the light of only 13 Carcels. The total quantity of gas consumed in the improved lighting is rather more than three times as great as before; but by the employment of better types of burners, it is made to yield 7½ times as much light. With regard to cost, for the Rue de la Paix it works out (at 15c. per cubic meter, the price charged to the Municipality) to 0.87c. per Carcel-hour; and for the Avenue de l'Opera to 0.74c.

It will now be interesting to compare, on all points, these improved systems of gas lighting with the electric lighting in the Rue Royale. This, as those of our readers who have visited Paris will remember, is the rather broad street, about 350 yards in length, extending from the front of the Madeleine Church straight into the Place de la Concorde. It is an important thoroughfare, and one which has figured conspicuously in most of the internal troubles which have from time to time convulsed the city. All through the day, and even well into the night, there is a continuous stream of vehicles passing along this street on their way to and from the Champs Elysees; and during the exhibition the traffic in the evening was very heavy. The area illuminated is 10,500 square meters, or about 12,500 square yards, in extent; and there have been employed for the purpose 25 electric arc lamps, each of 70 Carcels, or something like 660-candle power. This works out to about 0.160 Carcel per square meter, as compared with 0.108 Carcel for the Avenue de l'Opera, and 0.138 Carcel for the Rue de la Paix. With regard to expense, the electric lighting in the Rue Royale cost 55c. for 75 Carcels, or about 0.73c. per Carcel-hour, against 0.74c, for the Avenue de l'Opera and 0.87c. for the Rue de la Paix. These figures, at first sight, show slightly in favor of the electric light; but it should be borne in mind, as pointed out by our contemporary the *Journal de l'Eclairage au Gas*, that the calculation of the comparative expense of the two modes of lighting is not founded upon actual cost prices, and therefore the figures arrived at could not serve as the basis of a working contract. The Editor of the above-named publication maintains that, taking the net cost on both sides, including interest on the capital outlay, the trials here referred to would show an economy of about 50 per cent. in favor of gas. With the net price arrived at, it is, of course, open to anyone to add thereto whatever profit he expects to realize.

So much for the comparative efficiency and the cost of the two systems of lighting. It remains now to deal with the question of convenience and reliability. The warmest partisans of electric lighting are compelled, by force of circumstances, to acknowledge that, like Homer, it "sometimes nods," and occasionally does more—it goes to sleep, to the great inconvenience and danger of those who are dependent upon it. The electric lighting on the boulevards of Paris has been no better in this respect than some other installations that could be named; and, as the gas lamps were dispensed with, if it had not been for the lavish use of gas by the shopkeepers, serious accidents might have resulted. From the point of view of reliability, therefore, the electric light does not commend itself to the municipal authorities for permanent adoption on the boulevards; and it is doubtful whether, at the termination of the existing contracts, they will be renewed for the winter season, when there is the greatest need of light, and when, consequently, sudden extinctions are so much the more to be feared. As an additional feature of attraction during the period of the exhibition the electric light on the boulevards had a *raison d'etre*. While the city was "bagging" the money spent by the five million provincials and the million and a half of foreigners who visited the great show in the Champ de Mars, her rulers could afford to be a little extravagant in the way of illumination. But will they care to be equally lavish now that the excitement is over, and the "brilliant dream," as it has been called (though it must be confessed that there was a very substantial element of reality about it), has almost faded away? One is inclined to think not; and if this should turn out to be the case, will any attention be given to the older and less tricky illuminant with the view of seeing what can be done to employ it to the best advantage on the boulevards? The gas lighting in the two thoroughfares already referred to is evidence of the capability of gas to fulfil all the requirements of a public illuminant; and the municipal authorities are about to show their confidence in it by adopting a new type of high power burner—the "Industriel"—for the lighting of the Place de la Republique, in substitution of the burners now in use there, which are of the kind already referred to as having been introduced a few years ago for lighting the Rue du Quatre Septembre. The old 1400-liter burners will be replaced by "Industriel" burners consuming 1200 liters of gas per hour; and the 875-liter burners by those passing 750 liters. When this change has been effected the total quantity of light afforded by the new burners and lamps will be about three times as great as by the present appliances; and at the same time there will be a saving of 62 frs. per annum in the cost of the gas consumed in each of the lamps. One of these burners, passing 1200 liters of gas per hour, has been tested photometrically against one of the Edison electric lamps on the boulevards, and the latter was found to possess 1½ times as much illuminating power as the former. But then the Edison lamp costs 59 c. per hour, whereas a gas light having the same intensity could be obtained with Paris gas for 23 c. It would therefore be possible for the Paris Municipality to have twice the present amount of light on the boulevards by using high power gas burners and lamps of the most improved type, and at the same time effect an economy as compared with the cost of electric lighting. Whether or not they will avail themselves of these appliances remains to be seen.

(Continued from p. 822.)

Photometry.

By John Methven, Assoc. M. Inst., C. E.

[A paper read before the Southern District Association of Gas Engineers, and reprinted from the London *Journal*.]

The results of the returned illuminating power of the same gas under a change of temperature, would naturally lead us to inquire what is the correct temperature to use. Thermostats have been introduced lately into some of the testing places, with the view of maintaining a regular temperature; but these are in the habit sometimes of shutting off the supply of gas to the hot-water boiler, with the result that, a cold night intervening, the temperature of the apparatus is reduced, and the next operation of testing is made under circumstances unfavorable to the returned quality of the gas.

These results due to change of temperature induced me to make some experiments to discover the actual cause of the difference of illuminating value of the same gas. For that purpose I used a standard light of carbureted gas supplied with a constant volume of previously dried air. To arrange this, I had the airholder removed from the photometer room into a larger room, where it would be unaffected by the change of temperature made in the testing room; and I thus made a standard of comparison which was constant in power. The results of the experiment fully corroborated my previous experiments, and showed that *the burner developed the highest illuminating value of the gas at the low temperature*. It was therefore clear to my mind that the increase of temperature did not in the end contribute to the higher returned value assigned to the gas, by improving the development of light in the burner. Its influence must have been exerted on the combustion of the candles in diminishing their light-giving value. If it was not from the fact before alluded to—that the density of the gas under the higher temperature was lowered, and a consequent advantage obtained from the correction—the difference would have appeared greater. I append the figures of one of the experiments, which in this case also was corroborated by others:

Temp. of meter.	Results by candles. Open photometer.	Results by constant dry air standard.
56	16.32	16.37
70¼	16.78	16.00

In these experiments we observe, as in the others previously mentioned, an increase of illuminating power of the same gas when tried by candles under an increased temperature, amounting to about 2¾ per cent.; while the constant dry air standard revealed a reduction of light value of 2¼ per cent. I have remarked that these results corroborate my previous experiments. Some few years since I was surprised with the result obtained by the improvement of the light developed by the flame of an Argand burner by causing the air which the burner inducted to pass through channels surrounded by ice in a vessel, made air-tight round the chimney gallery of the burner. The air thus reduced in temperature increased the development of light 10¼ per cent. This result was not expected by me at that early stage of my investigation, and at first I was doubtful of its accuracy; but the same results were obtained on repeating the experiments time after time. I was not long in discovering the cause of the increased power of the flame. It was due entirely to the fact of the removal of the aqueous vapor from the air by its reduction of temperature. This was very interesting to me at the time; for I found that lowering the temperature of the air supply to the flame produced an effect on the flame in the same direction that makers of regenerative burners were striving to obtain by directly opposite means.

A very interesting memoir of M. Bremond was published in the *Journal of Gas Lighting* on the influence of atmospheric rarefaction on the illuminating power of gas, in which he describes some experiments made at different altitudes over the line of the Northern Railway, of Spain. The apparatus was fitted in a goods van attached to a special train; and at the different elevations along the road his experiments were made. The conclusions he arrived at are that, with the increased altitude, the loss of iluminating power increases; and this he contends is quite independent of the influence of barometrical pressure and temperature in diluting the bulk of the gas itself. The general expression in English units of M. Bremond's rule for determining the loss of illuminating power of coal gas due to rarefaction of the air in consequence of altitude, irrespective of barometrical corrections, is as follows: The illuminating power of the gas of any given quality diminishes by 0.742 per cent. for every 100 feet of altitude. Here we have another instance of the alteration of density of the air influencing the work of the burner in developing the light of the flame; and although in London we cannot obtain anything like the altitudes M. Bremond found, we have a range of, say, 400 feet, which means an effect produced on the gas of, say, 0.3 candle.

Experiments on the Value of the Light of Candle Flames.

In making the following experiments, the light value of the flame of the candle was found to depend on the position its wick held with regard to the disc. It must be observed that candle flames, like flames from fishtail burners, possess a flat side and an end, which, I think, drawing

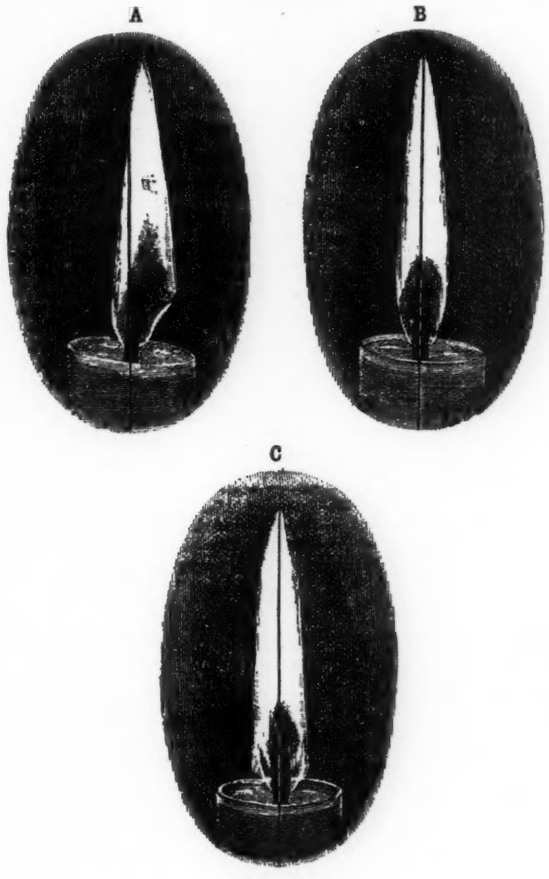

Fig. 3.

No. 3 will fairly represent. The centers of the flames occupied one terminal of the photometer, and the candles were movable, so as to place their wicks in the required direction. A Methven screen and disc box occupied the other terminal, provided with a supply of gas of constant quality; but as the screen value was rather greater than two standard candles, the mean lighting value of the candles appearing low must be attributed to this cause. The following figures are the mean results of a number of candles. Two distinct candles were used on each occasion:

Position.	Light value of candle flames in standard candles.
A. Plane of curvature of both wicks parallel to plane of disc	1.999
B. Plane of curvature of both wicks at right angles to plane of disc and bent away from disc	1.957
C. Plane of curvature of both wicks at right angles to plane of disc and bent towards the disc	1.933

Taking the mean light value of the two candles from these results as 1.972 candles, the position A gives a result 1.37 per cent. above the mean; position B, 0.76 per cent. below the mean; whilst position C gives 1.97 per cent. below the mean. It is evident, therefore, that the position in which the wicks of the candles are placed (although the centers of their flames may, by means of an adjustable candle balance, occupy the terminal of the photometer) must cause a difference in the results of the testing. The Referees in their "Instructions" state that "the candles are to be so placed that the plane of the curvature of one wick shall be perpendicular to the plane of curvature of the other wick." There are several positions shown on diagram No. 4, in which the wicks of the candles may be placed so as to comply with these "Instructions;" but

there is only one position in which they can be placed so that their mean lighting value should be exposed to the disc, and that position is marked 5 on the diagram.

This alteration of position of the candle wicks is of great importance in the Evans photometer, where the index on the scale represents the center of the candle. Diagram No. 5 represents graphically the error

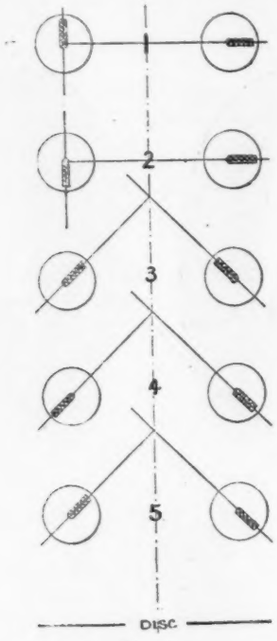

Fig. 4.

Diagram showing the various positions for placing the wicks of candles—all complying with the "Instructions" of the Gas Referees.

likely to arise from this cause. In the same manner the value of the candle flame was determined as above mentioned. The value of the light of the candle flame was observed when the center of the candle occupied the position of the terminal of the photometer, corresponding to the manner in which it is used in the Evans photometer. With the

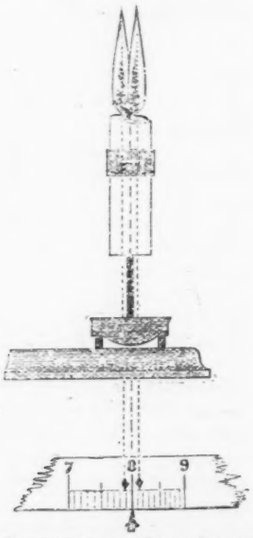

Fig. 5.—PHOTOMETERS WITH FIXED CANDLE HOLDERS.

Diagram showing the possible error due to the altered position of the candle wicks in the Evans Photometer. This error is increased on Photometers with shorter bars, and unprovided with adjustable candle balances.

wicks turned from the disc, the light value for 240 grains of sperm consumed by the candles was found to be 1.953 candles; with the wicks turned towards the disc the light value was 2.032 candles. This amounts to a difference of 4 per cent.; and the returned results of the testing will, of course, vary to that extent against the gas when the wicks are facing the disc, and in favor of the gas when turned in the opposite direction. The difference on the diagram is represented as being 3.6 per cent.—a result fairly agreeing with the photometrical results. The "Instructions" of the Referees provide for nearly one-half of this possible error; but to make them complete the position shown in fig. 4 (No. 5) should be adhered to. If candles were used in photometers in this position, the variations in photometrical results which have hitherto been ascribed to candles would to a great extent be removed. I have systematically used candles in this position, and the maximum and minimum variation from the mean of daily results, extending over 12 months, have been plotted on diagram No. 6*. Each day three separate pairs of candles were used in conformity with the statutory requirements—first in the open photometer, and afterwards in the closed photometer. To obtain a correct comparison, both photometers were connected to the same meter; and the same burner was used in each instrument. It will be observed that the mean variation on the open photometer for the year was above the mean for the day, 1.59 per cent.; below the mean for the day, 1.37 per cent.—together giving an outside variation of 2.96 per cent. The same candles used on the Evans photometer gave a result rather better—1.44 per cent. above the mean of the day; and 1.36 per cent. below the mean of the day, or an outside variation of 2.80 per cent. A Methven screen was used daily on the open photometer, and was found to possess a higher value, by 2.87 per cent., than the mean candle results on the open, and 5.78 per cent. on the closed or Evans photometer. This record of

*Fig. 6 consists of four elaborate diagrams, showing the value of the comparison flame burning 5 cubic feet of gas per hour, with candles on the open and closed photometers respectively and the Methven screen. The experiment extended over 12 months. One apparatus only was used for the two photometers; the open photometer used being of the Lambeth testing station pattern.

SERIES 1.—*The Methven Screen (used in the Open Photometer) Compared with the Average of Daily Tests by Candles in the Closed Photometer, gave the following Results, all Below the Mean:*

	Greatest.	Least.	Aver.		Greatest.	Least.	Aver.
Jan.	6.60	4.20	5.90	July.....	9.80	4.80	6.47
Feb.	9.30	2.70	5.60	Aug.....	7.30	3.75	5.40
March...	9.00	1.00	5.77	Sept.....	7.15	4.25	5.60
April....	9.00	3.50	6.35	Oct.....	6.50	4.30	5 40
May.....	8.80	3.60	6.17	Nov.....	6.75	4.50	5.60
June....	6.90	3.50	5.65	Dec.	6.60	4.40	5.50

SERIES 2.—*The Methven Screen Compared with the Average Daily Test by Candles on the Open Photometer gave the following Results, all Below the Mean:*

	Greatest.	Least.	Aver.		Greatest.	Least.	Aver.
Jan.	4.50	2.15	3.18	July.....	4.85	1.60	3.27
Feb.	4.50	0.75	2.90	Aug.....	4.70	1.50	2.68
March...	7.00	1.10	3.21	Sept.....	4.10	1.80	2.70
April....	6.50	1.35	3.21	Oct.....	3.50	1.85	2.40
May.....	5.60	1.00	3.02	Nov.	3.30	1.45	2.50
June....	3.65	0.80	2.55	Dec.	4.50	2.15	2.86

SERIES 3.—*In the Candle Experiments on the Closed Photometer, the Percentage Maximum Variations from the Average of each Series of Tests were as follows:*

	Above the Mean.			Below the Mean.		
	Greatest.	Least.	Aver.	Greatest.	Least	Aver
Jan.....	3.35	0.40	1.20	2.70	0.40	1.10
Feb.....	6.25	0.35	1.20	4.85	0.50	0.95
March.....	6.25	0.10	2.36	6.85	0.10	2.44
April.....	3.80	0.30	1.48	3.75	0.30	1.67
May.....	5.00	0.05	2.07	4.80	0.05	2.07
June.....	4.55	0.50	2.61	3.60	0.50	1.85
July.....	2.35	0.20	1.20	2.70	0.20	1.21
Aug.....	2.60	0.15	1.25	2.50	0.15	1.30
Sept.....	2.80	0.15	1.08	3.15	0.05	1.12
Oct.....	2.40	0.20	0.99	2.00	0.35	0.94
Nov.....	2.30	0.50	1 06	2.35	0.50	1.00
Dec.....	2.00	0.15	0.85	1.50	0.15	0.70

SERIES 4.—*In the Candle Experiments on the Open Photometer, the Percentage Variations from the Average of each Series of Tests were as follows:*

	Above the Mean.			Below the Mean.		
	Greatest	Least.	Aver.	Greatest.	Least.	Aver.
Jan.....	2.30	0.10	0.70	2.15	0.10	0.78
Feb.....	2.50	0.15	0.90	2.50	0.10	0.60
March	4.50	0.15	2.12	5.00	0.10	1.50
April	6.55	0.50	2.68	5.40	0.50	2.20
May.....	4.50	0.70	2.24	4.75	0.40	1.85
June.....	4.55	0.70	2.04	3.00	0.85	1.75
July.....	4.85	0.50	1.99	3.65	0.50	1.63
Aug.....	3.50	0.10	1.60	2.10	0.15	1.46
Sept.....	3.20	0.35	1.40	2.35	0.45	1.30
Oct.....	2.15	0.40	1.10	4.65	0.15	1.10
Nov.....	3.20	0.25	1.23	2.65	1.50	1.20
Dec.....	2.50	0.15	1.07	2.20	0.15	1.15

candle work is very interesting, as it may be compared with the results obtained by Mr. Dibdin, and published in his report to the late Metropolitan Board of Works in 1887. The results of the two investigations differ materially. They show how necessary it is, before a decision is arrived at to condemn the use of candles, that they should have fair play; that only parliamentary tests should be made and recorded; and that on all occasions the mean lighting value of the candles should be exposed to the disc. That the photometer room should be kept at a uniform temperature is not the least important condition.

My experiments in determining the amount of light developed by candles in an atmosphere of varying temperatures, show that, when the temperature of the air supply is at 50°, the developed light for 120 grains of sperm consumed was 1.198 candles; and by increasing the temperature of the air supply to 72° F. the power of the light developed was reduced to 1.041 candles, or a decrease of 13 per cent. The mean quantity of sperm consumed during the experiments was 120.2 grains per hour at the low temperature, and 119.7 grains at the high temperature—an inappreciable difference.

Professor Tyndall, in his work on "Heat a Mode of Motion," refers to experiments made by himself and Dr. Frankland, where they observed the different appearance of the flames of candles burning at the base and afterwards at the summit of Mont Blanc. He says: "The aspect of the six flames surprised us both. They seemed the mere ghosts of flames produced at Chamouni, enlarged, pale, feeble, and suggesting a greatly diminished energy of combustion. The candles being carefully weighed on our return, the unexpected fact was revealed that the quantity of stearine consumed above was precisely the same as that consumed below. Thus, though the light-giving power of the flames was diminished in an extraordinary degree, the rapidity of combustion was unchanged. This curious result is to be ascribed mainly to the mobility of the air at this great height. The particles of oxygen could penetrate the flame with comparative freedom, thus destroying the light and making atonement for the smallness of their number by the rapidity of their action. I find, indeed, that by reducing the density of atmospheric air to one-half, we nearly double the mobility of its atoms." My experiments on candles follow the same direction as those quoted above; but I am disposed to attribute the loss of light I experienced at the high altitude to another cause, viz., the presence of aqueous vapor in the air, which at the high altitude was present in greater volume than at the low.

I have made some experiments on the effect of aqueous vapor in the air and its influence on the light developed by candle flames. I find that candles, burning in the ordinary atmosphere, where the temperature from day to day was practically constant throughout the experiments, possessed a light value of 1.104 candles, compared with a light of constant power, per 120 grains consumed, which was increased when they were burnt in a dry atmosphere to 1.196 candles per 120 grains, or an increase of 8.38 per cent. This great difference in the light value was due only to the removal of the aqueous vapor with which the air of the room was laden, and, I think, due to that cause alone, for the mobility of the air was unaltered as the temperature remained the same.

Experiments on the Influence of Aqueous Vapor on Flames from Different Burners.

Diagram 7 (in which the ordinates represent the temperature of the air supply to the burners, and the abscissæ the illuminating power in candles) shows the effect produced by supplying flames with dry and saturated air at a constant rate. The lines marked A show the development of illuminating power from a flame consuming 5 cubic feet per hour in a Sugg's "London" Argand, when supplied alternately with dried and saturated air. The dotted line represents the dry air supply, and the black one the saturated air supply. It will be observed, when dried air is supplied to the flame, the light therefrom is practically of constant quality; but when a saturated air is supplied, with increasing temperature, the light value is rapidly diminished. Thus we have, between the temperatures of 50° and 75°, a loss of 10 per cent. of light value from the 5-feet flame. The lines marked B represent the results produced from the same cause on a flat-flame burner consuming a fixed rate of 5 cubic feet per hour within a globe. With dried air supplied to the globe, a constant value of light results at all temperatures; but with a saturated supply, the light value diminishes as in the former case. Between the temperatures of 50° and 75°, 11.2 per cent. loss of light occurs. Lines marked C represent the effect produced on a flame of ordinary gas 2½ inches in length, consumed with a chimney, from a Harcourt's pentane standard burner. With dry air supplied to the flame, the light was absolutely constant; but when a saturated air was supplied, loss of light, increasing with the temperature, was the result. Between the temperatures of 59° and 75°, the reduction of light value was 13 per cent. Within the ranges of temperature which I have selected as being possible—changes which may occur in any testing place—there is a marked increase in the loss of light between the experiments A, B and C. This I believe to be due to the powers of the different lights to battle with the aqueous vapor with which the air was charged.

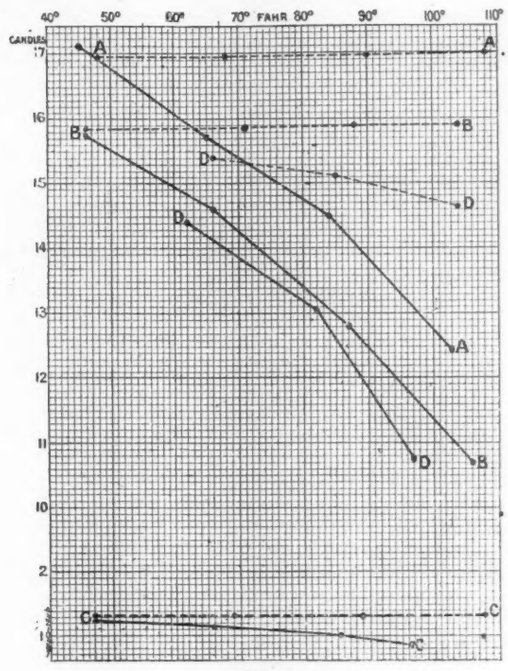

Fig. 7.

In carrying out the above experiments, I arranged an apparatus which made provision for dispensing with the forced, or controlled, supply of air, and permitted the burner to induct its natural air supply. Lines D on diagram No. 7 represent the development of light from a 5-feet flame in an Argand burner supplied with its natural supply of air. The amount of air inducted by the burner under these conditions was ascertained, after each experiment, by closing the large port and attaching the tube conveying the controlled supply of air. The rate of air was then adjusted so as to attain the same development of light from the flame, which was at all times burning at a rate of 5 cubic feet per hour. It was found that, as the temperature increased with dried air, the burner inducted a larger volume of air. Thus at the temperature of 66°, the illuminating power of the flame was 15.4 candles, and the volume of air was found to be at the rate of 34.26 cubic feet per hour. At 85°, the light was reduced to 15.1 candles; while the supply was found to be equal to 37.62 cubic feet per hour. Increasing the temperature to 104°, the light was reduced to 14.7 candles; while the air supply was found to be 39 cubic feet per hour. Increasing the temperature to 104° the light was reduced to 14.7 candles; while the air supply was found to be 39 cubic feet per hour. When the air supply was saturated, very nearly the same increased volume was inducted by the burner, with a similar reduction of developement of light, as with the other saturated air experiments. It was evident, however, in the last experiment, that if a constant light was desired, a constant volume of air must be supplied to the flame within the chimney.

Subsequent experiments, indicated on diagram No. 8, showed that, with either dry or saturated air, with an increase of 48.8 per cent. of air, I obtained a decrease of light of 20 per cent.; or, in other words, a decrease of illuminating power equal to 0.076 candle for every 1 per cent. addition to the air supply. In the case of the saturated air supply, although the experiments are not comparable, as they were not made with the same gas, yet I find a very similar reduction of light with an increased air supply—50.6 per cent. of increase in the air supply resulted in a decrease of illuminating power of 21.3 per cent., or an increase of 0.071 candle per 1 per cent. of increase of air supply. These experiments are useful in showing quantitatively the effect produced by increasing or decreasing the supply of air to Argand burners. In substituting chimneys of various sizes, the amount of air inducted by each might be arrived at by determining the light value of the flames.

It must be remarked that the experiments on diagrams Nos. 7 and 8 represent exaggerations of results which are likely to occur in the

natural condition of our atmosphere and to standard burners consuming gas under normal conditions. The experiments with a supply of moist and dry air was made in rapid succession, and the density of the atmosphere of the room in which they were conducted remained constant, as did also that of the gas; but they are useful in showing what an enormous effect is produced on the combustion of flames by the presence of aqueous vapor in the atmosphere in which they are consumed. Also, in the case of the increased air supply, taken in connection with the remarks I have made on standard burners, prove that the light developed by these burners is entirely under the influence of the condition of the atmosphere for the time being. Alterations in the density of the atmosphere

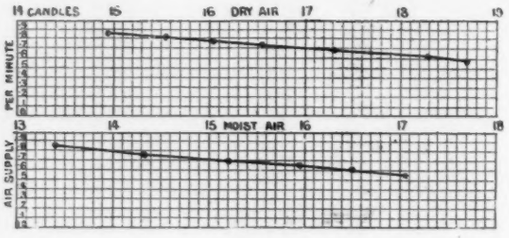

Fig. 8.

must either increase or decrease the power of the chimney for inducting its volume of air; which volume must in its turn influence the development of light from the flame as it is varied. For the same reason, any form of construction of the photometer which tends to cause the atmosphere in the vicinity of the burner to take an upward direction, must present additional facilities for the burner to induct more air than it otherwise would, and consequently affect the development of light from the flame. Also, any form of photometer which tends to decrease the temperature of the air surrounding either the gas or the candles, must in its turn cause the burner to induct more air, and the candles to develop more light, as my experiments show they are wont to do. Under these circumstances, I think I am justified in stating that without an atmosphere of constant barometrical pressure and temperature, the development of light from the flame within an Argand burner will always vary. As the Argand burner is the measure by which the gas is measured and sold to the public, it is evident that elasticity is one of its properties; and although it may be lodged with the Warden of Standards as a standard, it is a fact that we scarcely have two days in succession when it can possibly give the same development of light from the same gas.

I expect my remarks on this subject will not be indorsed by our scientific friends, who, I doubt not, possess the idea that the presence of aqueous vapor, and its effect on flame combustion, is the same with every flame, and therefore it cannot possibly influence photometry. The decision I arrived at is based on the results of my experiments. I have shown that within a range of 22° Fahr., candles vary in the light they develop to the extent of 13 per cent.; a flame from a Harcourt burner within the same range varies nearly 10 per cent., whilst the flame from an Argand burner varies only 8¼ per cent. It is well known also that with all open flames the greater development of light per foot of gas burnt is obtained from an increased consumption. A combination of small flames will develop more light per cubic foot collectively than each flame will do singly. This result undoubtedly is due to the same effect which produced the difference in the percentage of loss of light in the Argand burner compared with the candles—viz., to the size and consequent power of the flame to withstand the cooling effect of the action of the aqueous vapor in the air. It is evident from what has been said that any flame, or part of a flame, which may have been used or intended for a standard of light must from day to day be affected by variations of temperature or barometrical pressure of the atmosphere. It is further evident that any flame thus used has been misnamed, for a standard of light, to be a standard at all, must possess an unvarying power.

In considering the question of the varying development of light from flames, I was induced to analyze the flame of an Argand, especially the portions of the flame used in the Methven screen for photometrical purposes. Diagram No. 9 represents the light value of the horizontal portions of the 2½-inch flame, burning under natural conditions, and also under conditions in which the supply of air to the carbureted flame is controlled and freed from its accompanying volume of aqueous vapor. The diagram is drawn to scale; the horizontal divisions representing the flame divided into spaces ¼ inch deep. The vertical lines represent candles and tenths of candles. Scales marked *D*, *C*, *B* represent respectively the value of the horizontal portions 4, 5, 6, 7 and 8 when supplied with a natural air supply at temperatures of 50°, 70°, and 90°. The variations, colored black, show graphically the effect of temperature on that portion of the flame used for a photometer standard. Scale *A* represents at the temperature of 90° the effect produced by a saturated atmosphere on the same portions of the flame. An inspection of the diagram will reveal an important alteration in this case. The scales below, marked *G*, *F*, *E*, indicate the value of the same portions of the flame when supplied with a dried atmosphere of varying temperatures, but of constant volume. It will here be observed that the values of the portions of the flames colored black are practically equal, so that it is quite

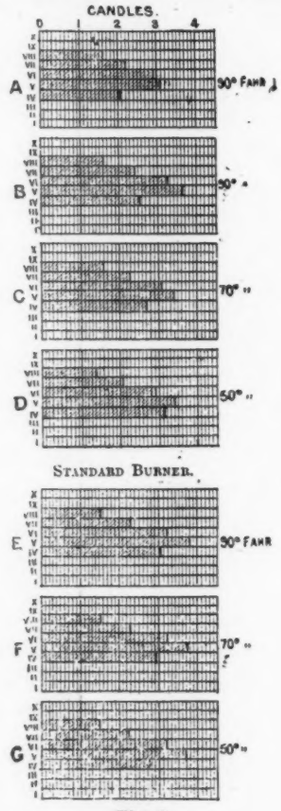

Fig. 9.

Light value of the horizontal portions (¼ in. deep) of flames, with varying conditions of air supply.

possible to take a portion of the flame so supplied with a dried air which shall, under all conditions of atmosphere, give a standard amount of light with unvarying regularity. We saw by diagram No. 7 that the whole flame of an Argand burner gave a constant amount of light when supplied with dried air; we now have proof that the detailed parts of the flame possess separately a uniform power under a wide range of temperature. A standard of light of such construction, and one worthy of the title, I have the honor to submit for your inspection, attached to a new description of photometer.

I have endeavored to show in this paper—which I fear is getting rather a long one, and consequently incurring the risk of straining your patience—first, that the action of the Gas Referees in altering the photometers in the manner they are now doing is calculated to engender the feeling that impartiality is conspicuous by its absence. Second, that in prescribing the standard burner, they have disregarded the small chimney with which it is associated, and prescribed the use of one which oftentimes fails to develop the full value of the gas. Third, by the interpretation of various clauses in the Acts of Parliament to which I have referred, I hold they are not justified in making these changes. I have shown to what an extent changes in our variable atmosphere alter the light-developing qualities of the standard burner, and also of the standard candle. I have further shown that, despite the care exercised in using these candles, there is an influence operating on the development of their light which we cannot well control. The actions of the Referees, I fear, we must put up with—at any rate, until they see in another light the effect of the alterations they are now making. With regard to the burner and the candles, I am prepared to make some suggestions which to my mind tend to make photometry a more scientific art, and impart

to it accuracy—a quality which, I venture to say, it does not now possess, or ever did.

My suggestions are incorporated with the new form of photometer which is here for your inspection to-day; and to which I have already in some measure referred. The burner for consuming the gas to be tested is provided with an arrangement for supplying it with a controlled supply of dried air. For convenience to-day I have fixed to the air holder to which the burner of the photometer is connected a power meter, which I hope will succeed in preventing the necessity of refilling the holder each time it is exhausted; but for ordinary work the power meter may be dispensed with and the air holder alone used. The air holder possesses the usual scale of cubic feet; and by this means the volume of air delivered to the burner may be regulated. By a series of weights of various sizes the rate of air can be regulated with precision, even in the case of the antiquated holder before you. By opening the port in the air chamber under the burner the gas may be lighted. The holder being weighted to suit the temperature and pressure of the air, the burner may now be supplied with its corrected volume of air for the time being; and by closing the port all communication with any other air intake is severed. The gas to be tested is under these conditions supplied at all times with the same volume of air. The carbon constituents (from the very fact of the flame being maintained at a height of 3 inches, irrespective of the rate per hour necessary to produce it) will at all times have the same volume of oxygen for their combustion, and, of course, the development of light will be in proportion to the quality of the gas, and cannot possibly be affected by any other factor. I propose to adopt the same attachment to the burner which yields the light of comparison; but in addition to drying the air supply to the burner I pass the gas used first through a desiccator, then over pentane. Provision will be made, as at the other end of the photometer, for delivering a corrected volume of air, which, of course, will always be deprived of its aqueous vapor. This will result in the standard of light (which will as usual be a portion of the flame only) being absolutely consumed without the presence of aqueous vapor; and as the volume of air supplied will be at all times corrected in volume, I venture to predict that the result will be a constant and unvarying standard of light. The combination of the disc and standard represented in this photometer is useful in maintaining a constant emission of light through the slot; and the tunnel through which this light passes into the disc delivers the whole of it where it is required, and effectually prevents the access of other light which is not required. The facility for moving the light to be tested, and the advantage of the long scale, have been before alluded to. The description of the instrument is thus completed. For general use I fear the introduction of such an instrument may be attended with some difficulty connected with the fulfilment of statutory requirements; but for scientific purposes, and when accuracy of results are required, I have the greatest confidence in its behavior, as its results when once rated will, at all seasons of the year, and with their attendant changes in the condition of the atmosphere, produce the true value of the gas to be tested.

I have also the pleasure of showing you in operation an improved jet photometer which I have altered in such a way that the main objections attached to the old form of instrument are removed. A jet photometer is essentially a very delicate instrument. It is exceedingly sensitive to changes of temperature. In the improved instrument I have water jacketed the whole of the gas-ways, to which I attach a small circulating pipe, so that I can maintain the gas at a constant temperature. The temperature I adopt is 80° F., having found it a convenient one to use, as it leaves a sufficient margin in the hot weather for adjustment. This alteration, you will observe, removes one of the chief objections. The next one I have overcome is the effect on the instrument of barometrical pressure. I have succeeded in doing this by adjusting the height of the flame so as to suit the barometer for the time being. The scale I adopt is the result of observations extending over 12 months. Daily a comparison was made, after the temperature of the instrument was adjusted, with the indicated results of the Letheby photometer on which the Methven screen was used. The observed differences in the readings of the jet and the photometer were noted and tabulated with the barometer readings; the result being that at the termination of my period of observation I had a considerable number of results under each alteration of barometer, tenth by tenth, which afforded a very reliable mean result. I was thus able to prepare a diagram, from which I have made the scale attached to the instrument for correcting height of flame to suit the barometer. The action of a high barometer on the jet flame is twofold. In the first place, the volume of combustible material is compressed, and there is consequently a greater quantity to pass through the orifice of fixed dimensions under the same pressure, producing a longer flame; and, in the second place, the higher density of the atmosphere in which the jet is consumed tends to decrease the length of the flame. So the high barometer acts upon the flame in both directions. It was this factor which necessitated the observations under a range of pressures which I have made. I have referred only to the high barometer. Of course, the reverse effect is produced with a low barometer. These combined alterations are improvements which will speak for themselves,

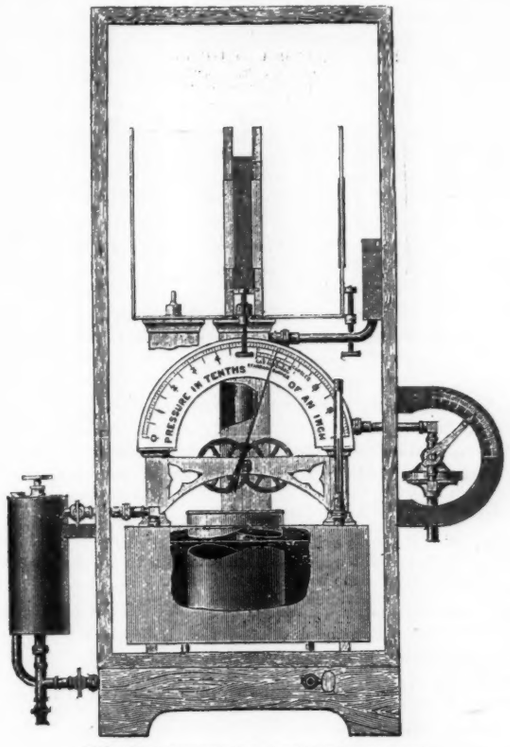

Fig. 10.—Methven Improved Jet Photometer.

and it will be enough for me to state that they impart to the instrument a degree of reliability which enhances its value to the gas maker considerably. The instruments can be rated so as to agree with any photometer, or adjusted to indicate within a moderate range the value of the gas with which they are supplied.

In drawing my paper to a conclusion, I must apologize for its length. The circumstances under which it has been prepared have to a great extent denuded it of the charm which generally fascinates writers on pet subjects; and its completion has been to the writer a great difficulty. But if it results in a good discussion his labor will be rewarded, and the time of the meeting will not be absolutely wasted.

[Concluded from page 824.]

The Application of Iron and Steel to Building Purposes.

[A paper read by Mr. T. F. Reade before the Royal Institute of British Architects.]

Compound Girders, or Rolled Joists with additional Flange Plates Riveted on.—A very useful and economical form of girder can be made in this way, and the mode of calculating its strength or sectional area is identical with that given for wrought iron girders further on, with this difference, that, considering the inferior quality of the material in rolled joist flanges, the limits of stress for these sections should not exceed five tons per inch of sectional area, and, in calculating this, only one rivet hole need be deducted from the joist flange, the holes not being placed opposite to one another. The greater part of the flange section being usually in the joist itself, fewer rivets are required to attach the plates than in a built-up girder. If only a single plate top and bottom is used, ¾-inch rivets at 8-inch pitch placed zigzag will suffice. The holes for rivets in the joist should always be drilled, for the iron in the flanges must necessarily be under worse conditions than the rest of the metal in the joist; and I have often seen cracks in rolled joist flanges extending from the rivet holes to the edge, the strength of girder being diminished thereby to the extent of 10 to 20 per cent. Heavy section rolled joists, carrying loads not exceeding 20 tons, may sometimes have their attach-

ments made to columns by bolting the webs to lugs cast on the columns; but in the case of heavier loads, and nearly always in the case of compound girders, vertical angle irons should be riveted on each side of ends of web, partly to act as end stiffeners to it, and partly as a means of making a more reliable connection to the column or stanchion.

Wrought Iron and Steel Riveted Girders.—The process of calculating the strength and designing the section of a girder must now be briefly described. The span of a girder—for calculation—is the distance between the centers of its bearings, its depth is the depth between the centers of the sectional areas of the flanges—and in ordinary girders of angle irons and plate flanges it is usual to take the width of the web plates as the depth for calculation, and it is important that this should not be a very small fraction of the span; if less than $\frac{1}{20}$, it will either have extreme deflection, or be wasteful by excess of material in the flanges; or, if more than $\frac{1}{10}$, we shall probably have an excess of material in the web itself. A practical illustration being more useful than a bare statement of rules, we will suppose a girder has to be designed, of 20 ft. span, to carry a load of 30 tons, equally distributed over its length; we will assume that the circumstances of the case allow of almost any depth, and as the limits of $\frac{1}{12}$ to $\frac{1}{20}$ of the span have already been given, we will take the mean, or $\frac{1}{15}$ of the span, which is 15 inches; this will be the depth of the girder between the inside of the flanges, which in an ordinary girder may be considered as the centers of the sectional areas. The first thing to be determined is the measure of the effect of the load, or what is called the bending moment; in other words, the load in tons multiplied by the span in feet and the product divided by 8 for distributed loads, or 4 for a central load. As girders are all levers of one sort or other, and the principle of the lever is well known, it is not necessary to explain the divisors 8 and 4. $\frac{30 \text{ tons} \times 20 \text{ feet}}{8} = 75$ foot tons.

This is the effect of the load or greatest bending moment in the center of the span, and we now have to find what section of girder is required to resist it, or the moment of resistance. We have fixed the depth at 15 inches, and will suppose the material is to be wrought iron. If the load assumed above is a dead load—that is, a solid mass of brick or stone wall weighing 30 tons—the limit of stress for the material named should not exceed 5 tons per inch. If it were a mixed load—say, 15 tons of dead weight and 15 tons of floors which would never be completely loaded over their whole area—part of the floor load becomes hypothetical, and we may increase the limit of stress to 6 tons per inch. The latter case being the most usual condition, we will take 6 tons. The moment of resistance will then be the depth in feet, equal $1\frac{1}{4}$, multiplied by the limit of stress, 6 tons, multiplied by the sectional area of one of the flanges. As the moment of resistance has to be equal to the bending moment, the required area of the flange will be the bending moment, or 75 tons, divided by 6 tons, limit of stress, multiplied by $1\frac{1}{4}$ ft. depth, or $\frac{75}{6 \times 1\frac{1}{4}} = 10$ in.; this is the net sectional area of the flange after deducting rivet holes. It was formerly considered necessary to make the top flanges of wrought iron girder stronger than the bottom, but the general practice is now to make them equal, except under special circumstances, as, for instance, bridge or roof girders, where the top flange has no lateral bracing or other support. Most of the calculations for a girder can be determined by the rules of graphic statics, and you will find the modes of doing this very clearly and simply described in two books on "Strains in Iron Work," and "Designing Wrought and Cast Iron Structures," by H. Adams, published by Messrs. Spon. In designing girders beyond 30 feet long, and with flanges built up of several thicknesses of plates, it is necessary to make the plates in such lengths that their weight shall not exceed the limits allowed by the iron makers. This limit of weight may at present be taken at 6 to 8 cwt., and the limit of area at 30 feet.

It is of the utmost importance that all riveting should be done in the best possible manner. The "snap" or end of the rivet, which is hammered out while red hot, should project uniformly all round the diameter of the rivet; they should be of uniform size, and any of them showing radiating cracks, or being of a size much smaller than the others, should be condemned; also, wherever countersunk rivets are required for bearings, etc., the plates or angles should have the rivet-holes countersunk by the drilling machine, and show on the outside at least $\frac{1}{8}$ in. to $\frac{1}{4}$ in. larger in diameter than the size of the rivet-hole. It is a very common practice to trust to the taper given to the holes in the process of punching, and so save the small additional cost of countersinking. This cannot be too strongly condemned, as such rivets are often loose in the hole, and thus doing no work. It is easy to detect such loose rivets by placing the finger on the snap or countersunk end, and lightly tapping the head with a hand hammer; the movement of the rivet in the hole, if loose, is immediately detected, and they should be cut out and replaced by new perfect rivets. The process of designing a girder in steel is exactly as above described, except that a higher limit of stress is introduced into the calculations, it now becoming 7 tons for a dead load, and $8\frac{1}{2}$ tons for a mixed load of floors and brickwork, or floors only. It is not advisable to make the webs of steel girders as thin as the increased strength of the material would seem to render possible; except in girders of dimensions much beyond our present example. In the rivet-holes in both materials it is usual in good work that all holes should be drilled; but in *steel* girders of any description this *must* be done, for the effect of punching upon the steel is to weaken the metal for a certain distance round the hole. This is sometimes remedied by punching the holes to about $\frac{1}{8}$ in. less than the diameter of the rivet, and then drilling out the holes to the larger size.

I may mention an adaptation of iron to the purpose of shoring. It is very useful in the case of an opening requiring to be cut through a wall at such a height above the ground level that ordinary wood shores and needles would be costly, and also prevent business being carried on in the lower stories during the alterations. Rectangular frames can be constructed of rolled joists or channel irons, connected at the corners of frames by tightly-fitting bolts. The upper and lower members of the frames are then passed separately through small openings in the wall, and the vertical sides bolted up to them on opposite sides of the wall. The weight of the wall above can then be taken up by the frames by wedging or other adjustment, and the portion of wall between the upper and lower members of the frames cut away for the insertion of a girder or girders.

The phrase "builders' ironwork," which has unfortunately now become almost a trade term, cannot be too strongly condemned; it is used to designate an inferior description of work which is considered good enough for ordinary buildings; of course, where, as in buildings generally, the constructional ironwork is usually covered, the fine finish to girder work, such as planed edges of plates, is perhaps superfluous, except where flanges of girders are to be visible; but it cannot be too strongly insisted on that in other respects—such as good riveting, careful jointing, and good fitting of vertical web stiffeners, etc.—there is quite as great a necessity for good workmanship and materials in iron for buildings as in the best description of railway and bridge work, the loads to be carried being, in some cases, much greater than for many railway bridges.

Injury to Coal by Spontaneous Combustion.

In an interesting communication to the *Colliery Engineer*, by Mr. C. J. Woodbury, of Boston, Mass., the author says:

The questions pertaining to spontaneous ignition of coal have received the most extensive treatment from the various boards of investigation which have considered the subject. A recent fire due to this cause brings to light a new feature in regard to the subject.

The facts in the case were that about 5,000 tons of semi-bituminous coal, which were kept in two brick houses, ignited spontaneously in the early autumn, about the middle of September, the fire being discovered in the two houses within a couple of days of each other.

From the indications on the top of the pile furnished by the smoke curling in various places, it was apparent that the fire had extended throughout the whole mass; and the deposition of sulphur on the surface of the pile, as it condensed from the volatile matter rising from the interior of the pile, presented the appearance of a yellow dew.

Of the injury to the building by the heating of heavy brick walls to dull redness, and the burning of all timber in contact with the coal, we have nothing to do; but the method adopted by the underwriters in the settlement of the loss was certainly outside of the usual course taken in such matters.

This is, we understand, either to settle the loss on the basis of a lump sum which one party tries to increase and the other to diminish, until, in the spirit of exhaustion, rather than compromise, they settle on an average; and the other plan is to pay for the coal, and then sell it to small consumers by forcing the consumption by means of ruinously low prices, which do not reward the seller, and also interfere injuriously with the retail business in the vicinity.

The method used in this instance was to take a sample of the coal from a portion which was uninjured, and subject it to chemical analysis, which gave;

Carbon	76.50
Hydrogen	3.98
Mineral matter	12.13
Sulphur combined with iron	.79
Sulphur in organic compounds	.69

The calorific value of a pound of this coal, as computed from the above, equals 13,594 thermal units. Other samples were obtained from the average of the pile when about half of the coal had been removed to a yard, leaving an oblique plane, which cut through approximately the center of the mass.

These samples were collected from regular points over the slope, and taken to a clean pavement, where they were crushed and thoroughly mixed over to obtain a smaller sample for the purpose of analysis, which should represent the average composition of the coal throughout the whole slope. This analysis gave:

Carbon	74.13
Hydrogen	3.95
Mineral matter	13.18

The calorific value of this sample of coal amounted to 13,230 thermal units, 2.68 per cent., as the depreciation of the value of the coal by heating, and it was upon this basis that the loss upon the coal itself was reached. A sample of partially cooked coal, which represented an average sample of the coal actually injured by heat so as to make a noticeable change in its appearance, showed upon analysis:

Carbon	65.77
Hydrogen	1.36
Mineral matter	26.13
Sulphur total	.82

The calorific value of the coal amounted to 10,409 thermal units, or 22.7 per cent. less than that of the uninjured coal. The cause of the heating was undoubtedly due to the presence of sulphur in its combination with iron, forming iron pyrites.

A defect in the consideration of the liability of various forms of bituminous coal to spontaneous ignition has been due to considering the total amount of sulphur as the measure of hazard, an assumption which contains two errors sufficient in themselves to render that process of forming an opinion entirely unreliable, because the sulphur liable to produce heat by chemical changes under normal conditions is the sulphur in combination with the iron, forming iron pyrites. This disintegrates under the most ordinary conditions, while the sulphur in organic compounds is not liable to such changes.

Secondly, a measure of this liability is not shown by an ordinary chemical analysis, which represents a sample selected by averaging up a large number of specimens, but the danger is due to the greatest concentration of iron pyrites, and not to its average presence in the whole mass.

The Raising and Lowering of Purifying Covers.

The *Gas and Water Review* is printing an excellent series of articles on the "Construction of Gas Works," by Mr. W. Ralf Herring. In respect to his determinations concerning the handling of purifier box covers, Mr. Herring says that for raising the same many descriptions of apparatus are employed. Goliath or A frame, travelers running on rails at the ground level, overhead travelers worked by manual or hydraulic power, screw lifts, cranes and gibs, and direct-acting hydraulic ram lifts, all have their advocates, the most common being a crab winch traveling on iron rails, supported by wooden or iron girders having their ends inserted in the walls of the building or upon columns, the crab traveling over the center of the purifiers lengthways of the house. A foot-board on each side, secured by brackets, is provided for the men to stand upon. Each lid on being raised is traversed over the adjoining purifier, upon the cover of which it is allowed to rest until the operation of renewing the purifying material is completed, when it is returned to its position.

For covers up to about 10 ft. square a good form of lift is to have two wrought iron T girders, say 6 in. by 6 in. by ¾ in., supported by standards from the sides of the purifiers, and traversed by a carriage on four wheels, with flanges either square or V-shaped. The lift is accomplished by a screw passing through the body of the carriage frame, which is raised and lowered by a bevel wheel, through the boss of which a thread is cut, and is actuated by another bevel wheel working into it keyed to a shaft carrying on its opposite end a wheel having a grooved rim, within which are small projections for holding the links of the endless chain by which it is turned, the chain being sufficiently long so that the man can work the lift when standing on the ground, and move it out of the way.

In some instances this arrangement is employed for larger covers, but then it is necessary to have two carriages, one on each side of the purifiers, with separate attachments.

In cases where purifiers are in the open, it being impossible to fix girders in the wall, Goliath or A frame travelers are employed. These are made in a similar way to the others, excepting the girders, which are fixed to two A frames of wrought iron mounted on two tram wheels, each running on rails on the floor or on timber sleepers on each side of the purifiers.

Wrought iron frames are the lightest and best. They should be made of L, T, or ⊔ iron, well braced together; the tram wheels should be 18 to 24 in. in diameter, double flanged, and should be at least 6 to 8 ft. center to center on each frame, so as to form a good, wide base.

The gear to work the bevel wheels and lifting screw is attached to the standard and conveyed to the top by means of a shaft and bevel wheels. Instead of the screw and crab gearing, hydraulic power is now substituted. A traveler made with wrought-iron framing as before described, may be worked with a horizontal hydraulic ram and cylinder fitted with movable pulleys, the number of these depending upon the height the cover has to be raised and the stroke of the ram. A ram and cylinder may be fixed in the center of the girders, and by means of two chains the purifier cover may be raised on each side. The water pressure is best obtained by a pump attached to the framework, provided with a water cistern on top of the girders, except when the lift is stationary; in such cases the pressure is obtained from the accumulator of the hydraulic pumps.

The writer designed a lift for a single purifier some years ago, which was so placed that it was impossible to move the cover from over the purifier, consequently means had to be provided for suspending the same. This was done as follows: It was a 30 feet square purifier; on each side were placed three columns securely bolted to foundations, one column on the center line of the purifier on each side, and one on either side of these, 9 feet center to center, which were all connected at the top by a wrought-iron girder running longitudinally with the side of purifier. From these girders an arched lattice girder was thrown across the purifier from side to side, from which a hydraulic ram and cylinder of the usual form was fixed in the usual way. On each of the outside columns strong lugs were cast to form a hinge for suitable brackets which were secured thereto, and upon which the cover rested when lifted from the lute. The ram was designed for a stroke of 3 ft. 9 in., which on a double chain gave a lift of 7 ft. 6 in., the top of the brackets being fixed 5 ft. from the top of the purifier.

When the cover had to lifted, the brackets were swung on one side and the valve from the accumulator opened. As soon as the cover was clear of the brackets the valve was closed, the brackets swung under the cover, and the pressure released, the cover being supported from the brackets, thus forming a capital roof for the men to work under, and as there was a clear space of 5 feet between the top of the lute plates and the bottom of cover, there was not the slightest inconvenience suffered from the foul material. This arrangement answered admirably, and works well; and is much appreciated by the men in bad weather.

At any future time, when occasion required, I should adopt a similar arrangement for a line of purifiers modified as follows:

A line of columns on each side connected by a continuous girder from end to end longitudinally with the purifiers. It is necessary to have three columns at the side of each purifier, so that when the cover is being lifted the weight is directly over the center one, and the one on either side having the brackets attached for supporting the cover.

Instead of a separate girder with the lifting arrangement attached, over each purifier I should place train rails on the top of the longitudinal girders on each side, and provide the main lifting girder with train wheels, so that it could be traversed over any purifier. As at all times when a cover was being lifted, the main traveling girder would be directly over the two center columns, the longitudinal girders need only be sufficiently strong to carry the weight of the traveling girder with the lifting gear attached. By this arrangement cover would be provided for the men, except when running the barrows to and from the lime or oxide shed.

FROM the articles of incorporation filed in the office of the County Clerk of Syracuse, N. Y., on the 2d inst., giving existence to the Peoples Gas Light Company, it is determined that the projectors of the concern are Messrs. William L. Elkins, Jr., Thomas D. Finletter, and George S. Beans. It is also further revealed that the objects of the Company are to be "the manufacturing, selling, delivering, and disposing of illuminating and heating gas in Syracuse." The capital stock is $300,000, divided into 6,000 shares of $50 each, and the life of the Company is fixed at 50 years. The Directors for the first year are Messrs. W. W. Downe, W. M. Hager, and E. Fortwengler, of New York, and W. L. Elkins, Jr., and Thomas D. Finletter, of Pennsylvania.

Erfurth's Scaffold-Building Device.

M. Ottoman Erfurth, of Teuchern, Germany, has patented a contrivance (shown in the drawings) for fixing the cross poles to the uprights in scaffold building. According to his description, the holder is made of one piece of iron, and consists of a saddle-arm clamp provided with spur, and counter-arm provided with spur. It is fixed to the vertical pole by pushing it on sideways and turning it with a jerk, the arms

pointing in an upward direction. This can be done with one hand and in a few seconds. The holder fixes itself automatically, so that it is even superfluous to drive in the spurs with the hammer.

The holder thus fixed to the post permits the horizontal beam to be placed on the projecting saddle-arms, and its weight will tend to press the holder against the vertical post in such a manner that the spur on one side and the counter-spur on the other side will both enter the wood and prevent the holder from sliding off.

The holder is now made in two sizes, viz., 4¾ in. and 6⅝ in., and it may be pointed out that they can be used with equal security to posts of half their thickness.

The Near Future of Electricity.

By George Cutler.

We, who are unfortunate enough to have less than half of our probable time of life to look ahead to, are greatly pleased with the rapidity of electrical development, as it assures us the probability of seeing many of the wonderful advances to be made in the growth of the science, pure and applied. But we realize that the inventions and discoveries of the near future are likely to be closely allied to the accomplishments of the present. The development of new fields is to be left to succeeding generations. We can hardly hope to see the successful production of electricity in large quantities for commercial use, direct from crude material, instead of the present expensive method of passing our energy through the boiler and steam engine. The full understanding of the production of light by the firefly and the applications in that direction are certainly too far ahead to afford us a ray of hope of anything more than an imaginary picture of what will be done.

We may imagine that cities will be lit by some luminous compounds on the walls which will give out the light at night that they absorbed in the daytime, but in this we are letting our imaginations loose and getting so far away from the practical work of the present, that the time so spent must be charged to recreation and pleasure account. Whereas the time spent in forming mental pictures of the widest possible developments in directions at present pursued may prove very valuable. Our best inventions and discoveries are made by such use of the imagination.

The superiority of the electric light for certain purposes is well understood, and the great problem is to furnish it to all without stint or preference. The immediate demand in our large cities is for installations of hundreds of thousands of horse power instead of those of a few thousand horse power merely. As Americans it does not behoove us to ask the authorities to pass laws which will limit our work to that particular system that we have partially developed. The expression "We can't" should not exist in the American electrician's vocabulary, as it should always be supplanted by the question, "How can we?"

If all sorts of wires are run in all sorts of ways, except the correct ones, about the city of New York, and then an over-zealous authority takes steps that prevent the different lighting companies from keeping the heterogeneous mixture of wires in half-way decent working order, resulting in the death of several employees in quick succession, we do not need to assume at once that certain systems *cannot* be safely distributed. A careful, candid study of the situation to trace the cause of the accidents with a view to remedy the evil, is much more to our credit. The very small number of such accidents in the whole world during the existence of these necessarily fatal systems certainly indicates that the problem is comparatively simple. By using high-class insulated wires, such as are already largely in use, and by planning circuits so as to prevent such a snarl as now exists in New York, the danger can be almost entirely removed Some accidents are bound to happen, just the same as in other industries in our crowded cities.

Because 15 people "persisted in absent-mindedly blowing out the gas" in the city of Chicago in the year 1888, we do not strive to pass a law preventing the use of this dangerous mixture. Fortunately the scarecrow articles of a few interested individuals cannot block our industries in this country, and we may, therefore, look forward to the establishment in the near future of large installations for the distribution of energy by electricity. Why should we not have an installation in Chicago of 2,000,000 or 3,000,000 lamps instead of 30,000 or 40,000? It is sure to come. The electric light is needed in all the offices, stores, residences, etc., in the city, and they are going to have it. We need not hope to get it by a system that would necessitate an expensive station every half mile; therefore we must look for some means of distributing at great distances. This necessitates high pressures in the distributing wires, and some means of conversion which will reduce this pressure for the inside wires. The conversion by accumulators is being developed persistently, and it is hoped successfully, because they add to the property of changing the pressure the other great advantage of storing the energy until wanted.

The conversion of high pressure continuous current to low pressure currents by means of "direct current" or "dynamo convertors" is also being developed, and let us hope that the "wizard" of Menlo park will succeed to fulfil his promises in this direction, so that we may have a great variety of methods for accomplishing this much desired result. Thus far the success has been achieved by alternating currents, and they certainly promise well for the future. The ease and flexibility, so to speak, of changing the phases of the current in alternating currents attract the inventive genius of the industry at the present time.

But the dynamos for the large installations of the future are yet to be developed. They are not to be small machines of merely 1,000, 2,000 or 3,000 lamps, but they are to be of 50,000, 100,000 or even 200,000 lamps. The "armatures," so called, are to be built up in sections, with ready means of connecting together, and with safety appliances to prevent one bad section interfering with the lighting circuits. The field magnets, being free from trouble, are to be revolved and also divided into sections, so that the electricity can be cut out of one section without interfering with the other, the whole machine to be about like a long cylinder revolving inside a thin shell of armature coils. The whole steam plant is to be the perfection of steam engineering, studied to save labor and fuel, and to be thoroughly reliable.

Practically all the lighting in the large cities is to be done by electricity, and immense installations are to be common occurences.

All places using small powers will adopt the electric motor. The great saving arising by distributing these small powers from power centers is already appreciated. Another great use of electricity is just commanding attention, and that is the distribution of parcels. Instead of blocking the streets with parcel delivery wagons of the different firms, these parcels will all be distributed by electric carriers. The cities will save great sums in street and paving departments, and the individual firms will get their parcels distributed much more cheaply and more satisfactorily.

Possibly this scheme may meet the support of the philanthropic natures, who are advocating laws which will exclude dangerous electric currents because of a few deaths they have learned of. As more people were killed by teams in the streets of New York and Brooklyn in the last two years than have been killed by electric currents in the whole history of the world, any system which will reduce the number of these "fatal parcel carriers" to a minimum will appeal to their great love of human life for support. When the electric parcel carriers are established, perhaps a law can be passed which will prevent any firm from driving parcel delivery teams about the streets and thereby killing an average of over one person per week in New York, instead of using the harmless parcel carriers worked by electricity.

The transmission of power by electricity in mining regions is to be extensively applied in the next few years. Mines that cannot be worked at present will be made very profitable by using electric motors worked from distant sources. This line of work is especially attractive because the great benefit arising warrants a large outlay of capital to accomplish it; so the electrical engineer will have the satisfaction of being able to make everything first-class, without regard to cost.

Some Contract Prices for Electric Lights.

The following figures are taken from the report recently prepared by Commissioner Raymond, of Washington, D. C., who had been authorized by Congress to make inquiry as to whether or not the cost of arc electric lighting in Washington could be reduced. The supply at the points noted is based on an all-night lighting schedule:

Place.	Term of Contract, Years.	No. of Lights.	Price per Light per year.
New Haven, Conn.	3	146	$171.55
Wilmington, Del.	3	33	164.25
Tampa, Fla.	20	20	182.50
Atlanta, Ga.	3	150	120.00
Columbus, Ga.	3	40	108.00
Savannah, Ga.	—	100	255.00
Texarkana, Ark.	30	14	160.00
Pueblo, Col.	5	100	156.00
Trinidad, Col.	5	30	150.00
Indianapolis, Ind.	2	100	60.00
Leavenworth, Kan.	—	35	120.00
Louisville, Ky.	1	50	233.60
New Orleans, La.	4	948	130.00
Lowell, Mass.	—	182	182.50
Fall River, Mass.	—	40	180.00
Salem, Mass.	3	170	163.50
Springfield, Mass.	1	54	20.00
Worcester, Mass.	3	170	200.00
Adrian, Mich.	3	63	100.00
Albion, Mich.	1	33	135.00
Battle Creek, Mich.	—	65	200.00
Detroit, Mich.	3	673	178.85
East Saginaw, Mich.	3	126	120.00
Grand Rapids, Mich.	1	40	140.00
Jackson, Mich.	—	194	88.81
St. Cloud, Minn.	1	24	125.00
Natchez, Miss.	5	65	85.00
Kansas City, Mo.	—	65	200.75
Nevada, Mo.	20	16	125.00
Sedalia, Mo.	3	20	125.00
St. Louis, Mo.	—	2,250	75.00
Manchester, N. H.	3	240	142.35
Camden, N. J.	5	119	146.00
Salem, N. J.	1	32	80.00
Trenton, N. J.	1	106	182.50
Albany, N. Y.	6	481	182.50
Brooklyn, N. Y.	1	1,106	182.50
New York City, N. Y.	1	1,324	127.75
Poughkeepsie, N. Y.	1	210	123.00
Rochester, N. Y.	5	1,050	104.03
Syracuse, N. Y.	3	295	144.00
Carson City, Nev.	—	10	300.00
Dayton, Ohio.	10	146	150.00
Springfield, Ohio.	1	54	130.00
Steubenville, Ohio.	5	23	75.00
Toledo, Ohio.	5	400	100.00
Altoona, Pa.	1	32	98.00
Harrisburg, Pa.	1	240	90.00
Lancaster, Pa.	3	138	124.00
Pittsburgh, Pa.	3	500	104.00
Providence, R. I.	—	247	182.50
Nashville, Tenn.	3	150	82.77
Rutland, Vt.	5	56	280.00
Ellensburg, Wash.	50	7	180.00
Milwaukee, Wis.	3	135	150.00
Montreal, Que.	5	135	146.00

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

WE understand that it is proposed to organize a Gas Company for Adel, Iowa, and that the town will agree to give the enterprise encouragement in the shape of a public lighting contract for a term of five years. This place is the capital seat of Dallas county, Iowa, and is located on the Raccoon river at a point about 24 miles west of Des Moines. It can be easily reached, is growing rapidly, and bids fair to become an important center.

THE Williamsport (Pa.) Gas Company ceased to supply gas to the public lamps on the 1st. inst.

BECAUSE of an accident to one of its holders, the Macon (Ga.) Gas Company lost about 45,000 cu. ft. of gas on the morning of the 1st inst.

SOMETHING over a fortnight ago we reported that the Hillsdale (Mich.) gas works had been purchased by Mr. F. W. Stock, and in supplement thereto we may now state that the works were put upon the market in order that the provisions of the will of the late proprietor (J. C. Hartshorn, of Newton Center, Mass.) might be complied with. Two bids were submitted for the property, Mr. Stock's competitor being Mr. H. A. Branch, who had been Secretary and Manager to the Company since its organization in 1872. One great defect in the Company's position arose from the fact that it was distributing gas (in good part at least) through wooden mains, and the leakage was enormous; but this will be remedied at once by Proprietor Stock, who will, in fact, virtually reconstruct the main system.

THE new auxiliary water gas apparatus on the Laclede Company's works is now in working order. This addition to the plant is to be followed by an extensive annex to the purifying house. While not in a position to so state with authority, we nevertheless believe that the Laclede send-out for November last exceeded by 16 per cent. the quantity distributed during November, 1888.

MR. CHARLES S. POWELL, Secretary of the Richmond (Ky.) Gas Light Company, informs investors that that plant is in the market. From his statement concerning the property it is learned that Richmond contains about 6,000 inhabitants, and that the Company supplies gas to 125 consumers. The city is also a customer. Mr. Powell says that the business is remunerative under the present conditions of supply, but that the sendout could be greatly increased, from which we infer that the distribution system could be better than it now is. In addition to the gas works the same owners hold a franchise for the construction of a water works, as also a charter for an electric light company. The above properties can be taken by one purchaser, or separate parcels will be made of them.

IN response to the invitation of the authorities the following tenders have been made for the public lighting of Elizabeth, N. J.: The Elizabethtown Gas Light Company, 500 or more gas lamps, three-foot burners, from sundown until 1 A.M., $14.95 per lamp, or from sundown until sunrise $16—on a yearly contract; if a three-year contract were granted, the respective rates would be put at $12.25 and $13.50 per lamp. The New York and New Jersey Globe Gas Light Company—which now does the lighting—offered to supply naphtha lights on the following basis: One-year contract, to light until 1 A.M., $16.90 per lamp, or all night for $18.25; three year contract, $16.90, or $18.25, according to the burning schedule adopted. Propositions were also submitted by the Elizabeth Schuyler Electric Company, the Mutual Electric Association, and the Wheeler Reflector and Light Company, but as it is likely that the contract will be awarded to either the Gas Company or the Globe Company, the other figures are not given. The proposals were referred to the Committee on Lamps, Gas and Water, the members whereof, at

a subsequent meeting of the Council, reported in favor of awarding a contract for the lighting to the Elizabethtown Gas Light Company, on the basis of its long term proposition—*i.e.*, an all-night schedule, at the rate of $13.50 per lamp per annum, the agreement to run for three years. The resolution led to a lengthy discussion, and terminated in the recommittal of the entire matter to the committee for further examination. This action is, to say the least, peculiar. The present contractors are lighting 520 naphtha lanterns—lights are put out at 1 A.M.—at the rate of $19.25 each per annum, which means an annual outlay on the part of the city of $10,010, and under their current proposition they confess an inability to do the work for less than $9,490 per annum in the future—for three years, at least. On the other hand the Elizabethtown Gas Company's proposition would enable the authorities to take advantage of a much more reliable and satisfactory illuminating vehicle than that now supplied them, and to obtain the same at a much less cost. If, however, it is not desired to cut down the annual appropriation for the public lighting, but rather to increase the effectiveness of the system by the extension of public lights to districts that ought to be but are not so illuminated, then the Gas Company's proposition not only has the merit of greater cheapness with the added charm of increased efficiency and reliability, but also has the crowning glory of enabling the maintenance of 3 lamps where but 2 stood before. We do not see why the authorities refused to bind the bargain then and there, but presume that certain of "the fathers" were totally unprepared for the submission by the Gas Company of such "public-spirited" figures. Perhaps the award was only delayed and not without any desire of permitting the Globe Company's estimator to hand in a revised bid, but of this the subsequent records shall tell. In the meantime we congratulate the Gas Company on its evident determination to regain its lost prestige for public-spiritedness, and cannot help remarking that it is to be regretted that the change did not come sooner. All is plain, however, when one remembers that 'tis better late than never.

[Since the above was written, a contract for the lighting has been made with the Gas Company, on the basis of its 3-year offer.]

THE appropriation for public electric lighting in Chattanooga, Tenn., for the twelvemonth was put in the budget at the sum of $12,000, while the contracts awarded the Electric Lighting Company already foot up $25,940. In the meantime, as the day of reckoning approaches, some of the authorities are whispering that the lot of the Alderman is not always a happy one, because, under the decision of the Tennessee Supreme Court, in what is known as the Colburn case, it was there held that aldermen are personally liable on their bonds for all contract sums in excess of the budget.

AMONG the bids that will be opened by Director Wagner to-day for supplies (in classes A to W) for the Gas Bureau for a stated period are the following: A, coal (gas and cannel); B, lumber; C, hardware, shovels, etc.; D, paints and painters' material; E, iron and steel; F, oil and tallow; G, brass supplies; H, stationery and printing; I, wrought iron pipes, fittings, etc.; J, glass and matches; K, C, I, pipe, special castings, etc.; L, lead pipe, pig lead, etc.; M, purifying screens, etc.; N, telegraph, rubber and wheelwright supplies; O, jute packing, retort cement, etc.; P, dry meters; Q, belts and rivets; R, stable materials; S, oyster shells, naphtha and iron sponge; T, office and blacksmith coal; U, horse feed; V, hauling; W, clay retorts and firebrick. Proposals will also be opened for the carbon and old iron accumulated at the several stations during the past year.

THERE is much complaint in Newark, N. J., over the frequency and duration of the spells of inactivity that affect the public electric lights in that city.

AT a meeting of Philadelphia Council's Committee on Gas, the subcommittee authorized to inquire into the Toraya process reported that after consultation with Director Wagner they had decided to recommend that a test of the process be made at the Manayunk gas works, where the gas manufactured by that process can be isolated from the regular city gas, April 15 being decided on as the date when the works shall be handed over to the Toraya Gas Company for the experiment. The Committee also reported favorably an ordinance authorizing Director Wagner to pay for the gas manufactured by the Company at a cost not exceeding 45 cents per 1,000 cubic feet.

THE following notice, which explains itself, has been extensively advertised in the local newspapers by the Boston Gas Light Company: "Notice to gas consumers.—Important.—Gas pipes in the streets are frequently broken by the settlement of the streets after the pipes are laid. This settlement is caused by the disturbance of the soil by excavations for sewers, water pipes, electric wires, and more particularly for the apparatus of the Boston Heating Company. The Boston Gas Light Company is informed that the manholes and circuits belonging to the Boston Heating Company are now empty and unused. In case of a leak from a gas pipe in the street, these manholes might become depositories for gas, and as such would be especially dangerous. Attention is therefore again requested to the following rules: 1st. As soon as the smell of gas is perceived, either by day or night, immediate notice should be sent to the office of the Company, No. 24 West street. 2d. No light should be taken into any place where there is a smell of gas, and no match should be lighted. 3d. The windows in any room where gas is perceived should be opened at once and kept open. The attention of all your employees should be called to these rules at once, and a careful compliance with them should be enforced."

WHEN Charles E. Leland succeeded to the control of the Delavan House, in Albany, he determined to light that hotel by means of oil gas, and accordingly installed the necessary apparatus on the ground at the rear of the next block, north. The scheme worked fairly well, until about the 1st of the month, or until the "gas plant" blew up. The consequent conflagration consumed property valued at perhaps $80,000.

THE rates at Northampton, Mass., for the supply of incandescent electric lights have been increased considerably. In explanation of the advance (the price paid was equivalent to a charge of about $2.25 per 1,000 cu. ft. for gas) the proprietors of the electric company said that under the former schedule the running expenses of the station were not being met.

THE system of paying for incandescent electric lighting supply on a meter basis will not do in Brooklyn, N. Y. The proprietors of the new Clarendon Hotel (who propose to erect a handsome 6-story building on the northwest corner of Washington and Johnson streets) say, for instance, in regard to the use of the Edison light in the new structure, that they will only agree to take it provided a contract will be agreed upon to maintain the lighting for so much per month.

NEGOTIATIONS looking to the purchase of the Batavia (N. Y.) gas works by a syndicate of Edison capitalists are under way. There is little doubt but that the deal will be consummated.

SUPERINTENDENT R. W. ELLIOT, of the Consumers Gas Light Company, Jersey City, N. J., has been appointed Agent of the Hudson County Electric Light Company. While the latter Company will be nominally operated as a separate enterprise, it will in reality be a tender to the Gas Company. The electric plant will be in running order by February 1st.

ABOUT a fortnight ago Deputy Sheriff Bartow, of Brooklyn, N. Y., put up for sale, at the Liberty street station of the Citizens Electric Light Company, nine dynamos, a portion of the effects of the Brooklyn Incandescent Electric Light Company, and which were "stored" on the premises noted. The sale was made at the instance of the Ansonia Brass and Copper Company, which is a creditor of the Incandescent Company—the latter went out of business last September after a precarious business existence of about 10 months—to the amount of $885.45, and of the firm of Jno. A. Roebling's & Sons, who are creditors for $176.59. About half a dozen intending purchasers, including a couple of junkmen, and President Crittenden of the Incandescent Company, were present. Much to the disappointment of the junkmen, President Crittenden bought in the apparatus, for the gross amount of the two debts and costs, which he personally guaranteed should be paid within a week.

"MIDDLETOWN, Delaware, longed for public electric lighting, and finally got it in the shape of incandescent lamps—graded according to the suppliers' promise and guarantee to be of 32, 16 and 10 candle power, respectively. The residents, however, did not readily accede to the idea that the lights furnished were up to the standard lighting values promised, and finally it was determined to have the lamps tested by an expert, said tests to be conducted without the knowledge of the electric light company. The expert came, saw, tested and presented his report. The showing thereof is to the effect that the average of all the lamps tried is 42 per cent below their nominal lighting value.—HADDAM."

AT a meeting of the Trustees of the village of Mount Morris, N. Y., it was resolved to accept the proposition submitted by the Mount Morris Illuminating Company for the public illumination of the place. The

agreement calls for the maintenance of 24 arc lamps (1,200 candle power), to burn from sunset to midnight of each night in the year, at a cost of $49 each per annum, and 6 incandescent lights (32 candle power) to burn from midnight to sunrise, at a cost of $10.50 each per annum.

In referring to the public lighting of Newark, N. J., the *Journal* notes that the arc lamps paid for by the city are furnished by the United States and the Thomson-Houston Companies, at the rate of 40 cents per night. There are between 335 and 350 now in use on the principal thoroughfares. The cost of the electric light service in 1888 was $35,996.72, and for the first 10 months of the current year $37,627.85 had been paid out on like account. As the expense for November and December cannot fail to be less than $7.500, it will be seen that Newark's arc lighting in 1889 will call for the payment of about $10,000 more than the expenditure for the same purpose in 1888. In view of this it is thought that Mayor Haynes is inclined to favor the installation of an electric lighting plant to be operated on municipal account.

The following letter explains itself:

New York, Dec. 10, 1889.

To the Editor American Gas Light Journal: In your very kind and excellent notice respecting my new patented solvent for gas pipe deposits, a very important use for same was not mentioned, and you would greatly oblige my firm and save a large number of inquiries from all over the country by giving the following a prominent place in the next issue of your valued Journal: This solvent is an excellent *frost cutter* and *frost preventative*, as well as the most satisfactory cleaner of clogged gas mains and pipes, in point of efficiency and cheapness.

Yours truly, Dr. Martin E. Waldstein.

The Massachusetts Gas and Electric Light Commissioners have authorized the Danvers (Mass.) Gas Company to take up the supply of electric currents.

Mr. Nelson Hoyt, who for the past 14 years has been the faithful and efficient Superintendent of the Easton (Pa.) Gas Company, has handed in his resignation, to take effect on Friday next. Mr. Hoyt has taken service with a prominent construction firm of Philadelphia.

We regret to have to announce the death of Mr. F. W. King, well known to the fraternity as Inspector of Public Lamps, etc., for Baltimore, Md.

Mr. F. W. Jennings is constructing for the Cottage City (Mass.) Gas Company a new coal storage house, workshop, etc.

Mr. F. E. Nickerson, of the Stoneham Savings Bank, has been appointed Collector for that district by the Citizens Gas Light Company, Wakefield, Mass.

About a week ago State Gas Inspector Hinman paid an official visit to the works at Spencer, Mass., and found that the illuminating power of the gas supplied was equal to 20.70 candles. The carbonizing capacity of the Spencer plant has been greatly increased. In fact, the works can now be depended on to send out 100,000 cubic feet per diem.

The *Boston Advertiser*, in a sensible article on the care requisite in lighting lamps, etc., says: "In view of the destructive fires that have occurred within the past month, laying waste many factories and mills, it will be timely to inquire into the general fire hazard run by industries in other manufacturing centers of New England. The textile mills are without doubt subject to the heaviest losses, and the almost daily occurrence of fires, great or small, in mills of this class, whereby so much wealth, won by labor, skill and enterprise, is destroyed, is largely due to self-evident causes which, if properly attended to, would minimize the danger. Among the causes that operate to lay mills in ruins are: Spontaneous combustion from a negligent accumulation of waste materials, heated bearings from insufficient, careless or neglected lubrication of frictional surfaces; the accumulation of loose fiber upon beams, joists, steam and gas pipes, and other places from which it is likely to be dislodged by a violent draught from the opening of a window or door and thus thrown upon gas jets; accidents from lamps and fractured gas pipes, and other sources which space prevents from enumerating. There are some who think the best thing that can happen an old mill or wooden factory is the visitation of a heavy fire which shall wipe it out of existence, and then the building up of a modern fire-proof structure. They say that such old and worn-out plants are generally covered by insurance, but often their destruction has been a severe loss to the owner, simply because in the placing of such insurance a large reduction is made for depreciation on plant and machinery, which, though old, is of just as much value to the manufacturer as a modern plant or new machinery. Many of the Lynn manufacturers were affected in this way. Fires among the industries are generally more numerous at this season of the year, which is called the "lighting-up time," and it is not until the custom of caring for gas lights and lamps on the part of mill employees has grown more habitual that the danger to fire diminishes. Those mills using gas should carefully inspect the piping and see that it is firmly attached to the beams, joists or walls along which it is carried. If lamps are used they should be regularly examined, repaired if necessary, cleaned and trimmed for immediate use. Where electric lights are put in the same inspection should be given to connections and insulators. In many mills there is a great want of cleanliness, particularly in relation to periodical sweeping of the walls, joists, girders, shafting, pipes, etc. In the winter season such neglect is inexcusable and becomes a source of great danger. In most of the textile industries there is a large quantity of loose fiber and light dust thrown off in the processes which lodges upon the shafting, beams, stay-rods and projections of the walls. This loose fiber is of highly inflammable character, and is liable, owing to its extreme lightness, to be blown off by any sudden draught upon the lights below. Only a short time ago a heavy strand of this fiber was blown into contact with a gas jet in one of the departments of a certain mill during a heavy gale of wind, when it flamed rapidly to the roof and communicated to all the inflammable material surrounding. Fortunately in this case no further damage was done, owing to the presence of sprinklers. With proper attention to details in lighting, cleaning, etc., and a thorough equipment, where it is possible, of automatic sprinklers, fire pumps, extinguishers, etc., the danger of fires in mill buildings or factories is greatly lessened, and companies insuring will recognize such and make the proper allowance."

The Davis & Farnum Manufacturing Co., Waltham, Mass., has put in this season gasholders for Companies in many of the towns and cities of New England and the Provinces, purifiers for the Gloucester (Mass.) Gas Company, condensers and exhausters for Concord, N. H., and a complete set of gas works for Danielsonville, Conn. The Company has also furnished large quantities of cast iron pipes and fittings for gas and water companies, flanged pipe for electric light stations and sugar refineries. The steam pipes for the new West End Railway power station on Albany street, and the Salem Electric Company's station, were furnished by it.

At a meeting of Councils' Special Committee on Electric Lighting (Reading, Pa.), held last week, it was resolved to recommend to Councils that the city erect its own electric light plant, and an ordinance looking to this end was ordered to be drawn up for presentation to the next meeting of Councils.

At a meeting of the Niagara Falls (Canada) Council it was determined to grant to the Niagara Falls Natural Gas and Fuel Company the exclusive right to supply that commodity in the town for a term of 15 years.

Mr. F. Valle Nettleton has been appointed Secretary of the new Gas Company at Duquoin, Ills.

An odd suit was entered some days ago in the Magistrates' Court, Montreal, Canada, by Husmer Lanctot, on behalf of Joseph Thibault against the local Edison Electric Light Company. Plaintiff alleges that having entered a barber shop, in the Imperial Building, he placed his coat and overcoat on a rack near which incandescent light wires were being fixed, and that both coats were burned and damaged by the electric current to the extent of $20, which he now claims from the Company.

The Market for Gas Securities.

The chief attraction in gas shares on the New York Stock Exchange during the week was Chicago Trust stock, which zig-zagged in truly Chicagoese style. Having sold strongly at the beginning of the week, towards the close a decidedly weaker feeling was developed. This morning (Friday) it opened at 39⅝–¾, but the indications at time of writing are that higher figures will be made in it before the day's business ends. We are of the opinion that Chicago gas is a purchase at anything below 42 for a quick turn, and that at anything below 40 it is well worth the attention of investors. In city shares nothing of moment transpired during the week. Consolidated is at 88½, while Equitable is higher. The U. S. Equitable Company have declared a dividend of 1 per cent., payable on Saturday, December 21st. At auction, 18 Equitable, city, at 120½. Brooklyn shares are strong and steady. We note a quotation for Bay State gas at 43–44.

THE AMERICAN
GAS LIGHT JOURNAL

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PROPRIETORS.

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MONDAY, DECEMBER 16, 1889.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,
16 WALL ST., NEW YORK CITY.

DECEMBER 16.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	87⅞	89¼
Central	500,000	50	—	—
" Scrip	220,000	—	—	—
Equitable	4,000,000	100	120	127
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	116	118
Mutual	3,500,000	100	103	105
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co—				
Common Stock	5,000,000	100	—	—
Preferred	5,000,000	100	—	—
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	60	70
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	108	110
Citizens	1,200,000	20	68	70
" S. F. Bonds	320,000	1000	100	103
Fulton Municipal	3,000,000	100	120	122
" Bonds	300,000		100	105
Peoples	1,000,000	10	75	77
" Bonds (5's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	95	—
Nassau	1,000,000	25	112	—
" Ctfs	700,000	1000	100	—
Williamsburgh	1,000,000	50	118	122
" Bonds	1,000,000	—	108	112
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	—	93
2d " " "	3,000,000	1000	—	—
Bay State Gas Co.—				
Stock	5,000,000	50	43	44
Income Bonds	2,000,000	1000	—	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds	45,000	—	—	—
Chicago Gas Trust	25,000,000	100	39⅜	39¾
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	—	92¾
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	99
2d "	2,500,000	1000	—	98¼
Consumers Gas Light Co., Jersey City	2,000,000	100	—	—
Bonds	600,000	1000	—	—
Cincinnati G. & C. Co.	6,000,000	100	214	218
Consumers Toronto	1,000,000	50	190	200
Central, S. F., Cal.			80	90
Capital, Sacramento, Cal			58	
Consolidated, Balt.	11,000,000	100	43¼	43½
" Bonds	6,400,000		107	107½
Hartford, Conn.	750,000	25	102	108
Jersey City	750,000	20	190	—
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	19½	21½
Preferred "	2,500,000	100	—	—
Bonds	9,034,400	1000	—	91
Louisville, Ky.	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	48	51
" Bonds	240,000	100	103	—
New Haven, Conn.		25	200	—
Oakland, Cal.			35	35½
Peoples, Jersey City		—	60	61
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	99	100
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co.			60	60½
San Francisco, Cal.	10,000,000	100	59¾	60
Washington, D. C.	2,000,000	20	200	208
Wilmington, Del.		50	200	208

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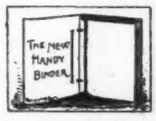

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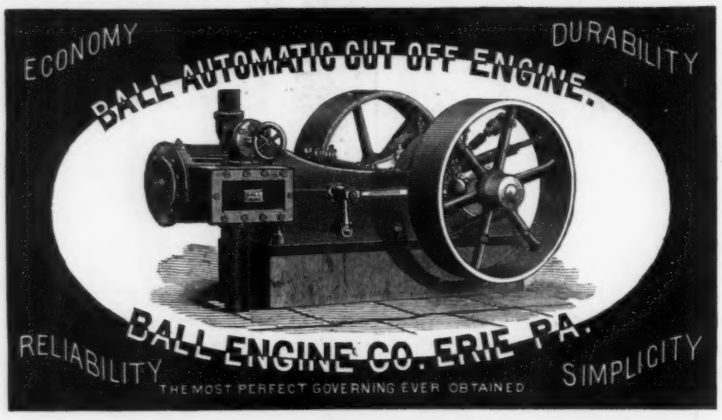

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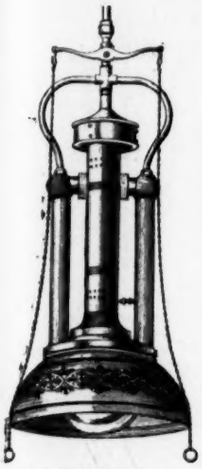

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A Successful Competitor of the Arc Electric Light for lighting Streets, etc., etc.

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A Successful Competitor of the Incandescent Electric Light for Interiors, etc. Is especially applicable for the lighting of Offices, Stores, Factories, Mills, Show Windows, Libraries, and all situations where an increased illumination is desired.

More than 25,000 Lungren Lamps are now in use. Testimonials, references, or any desired information will be cheerfully given.

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THE SIEMENS-LUNGREN CO., N.E. Cor. 21st St. & Washington Av., PHILADELPHIA.

JEWEL GAS STOVES

MANUFACTURED BY

GEORGE M. CLARK & COMPANY,

Nos. 157 & 159 Superior Street, - - - Chicago, Ill

EVERY CONCEIVABLE SIZE AND STYLE,

Ranging in Prices from $1.50 to $30.00.

WE USE NO GAS COCKS.

All Flames are Regulated by a Direct Needle Valve.

The JEWEL

IS THE

Only Well-Made Gas Stove on the Market.

Write for our 1890 Catalogue and see for yourself.

WELSBACH SYSTEM

OF

Incandescent Gas Lighting.

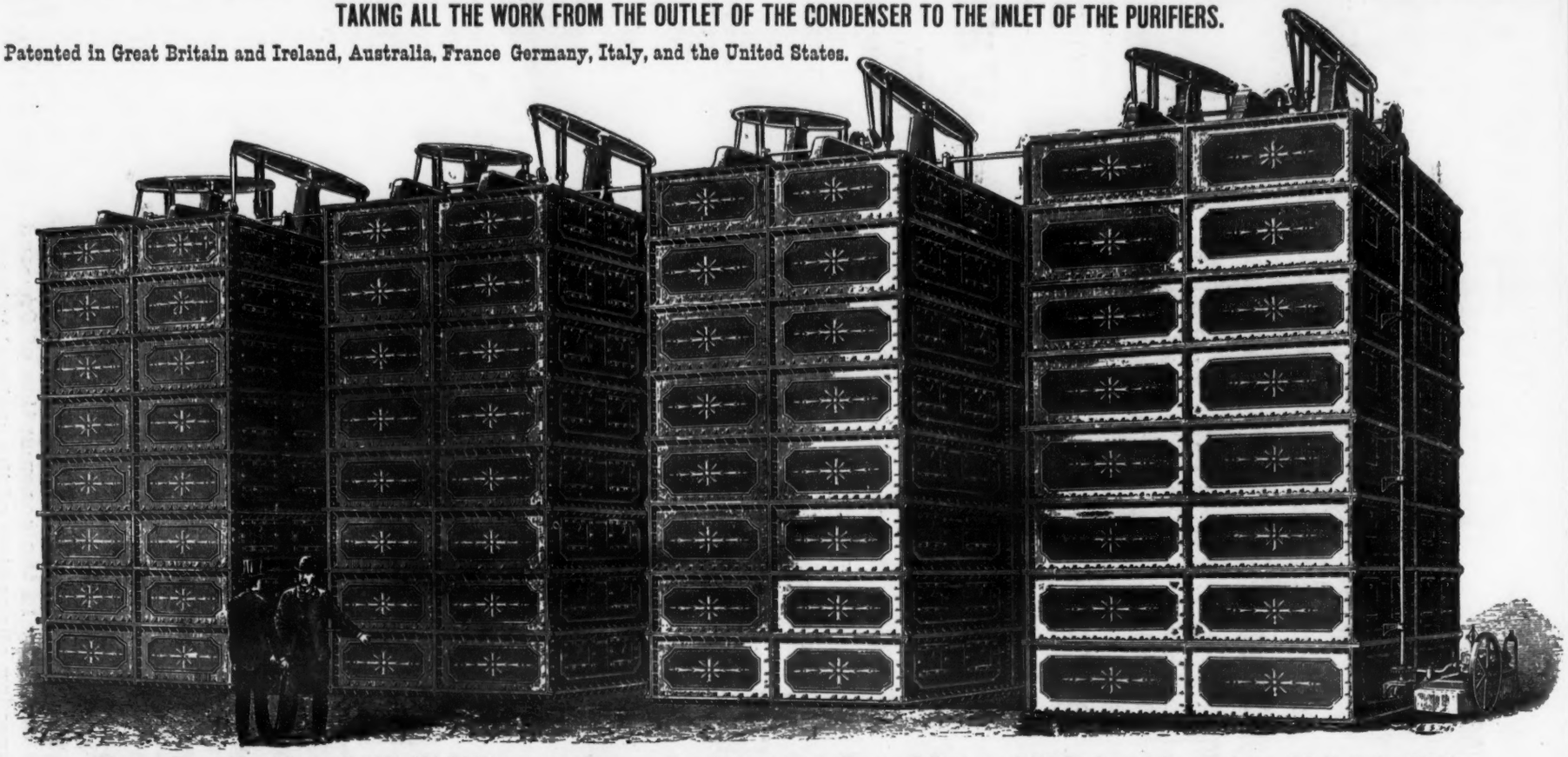
OFFICE, DREXEL BUILDING, PHILA., PA.

At the Fall Session of the Board of Supervisors of Winnebago County, held at the County Court House, Oshkosh, Wis., Nov. 26, 1889, the report submitted by Mr. C. W. Cook, Chairman of the Committee on Public Buildings, recommending the use of the Welsbach Incandescent Gas Burner in the Buildings under their charge, was unanimously adopted, because of the extreme economy in the consumption of Gas and the superior character of the light obtained.

C. & W. WALKER'S PAT. PURIFYING MACHINE.

TAKING ALL THE WORK FROM THE OUTLET OF THE CONDENSER TO THE INLET OF THE PURIFIERS.

Patented in Great Britain and Ireland, Australia, France Germany, Italy, and the United States.



These Four Machines Purify 12 Millions per Day, and only occupy a Ground Space of 60 ft. by 12 ft., and are 23 ft. 6 in. High.

Four of these powerful Machines for the new extensions at the Beckton Gas Works, London, are now working, purifying Twelve Million Cubic Feet of Gas per day, each Machine taking Three Millions per day.

These Machines can be seen at Beckton, where, after being long and abundantly tried, tested, and proved in every variety of working, have been accepted by the Gas Light and Coke Company, of London, as superior to all other apparatus for taking all the work of the purification of gas between the Condensers and the Purifiers.

The Machine is the most important improvement effected in gas works for years past. The purifying power developed is most remarkable. We send an Engineer with a working model to any Gas Company inviting information. It is equally adapted to gas works of any size.

DESCRIPTION.

The gas enters into the washing chamber at the lowermost part, where it is first subjected to a thorough washing in the strong Ammoniacal Liquor. The washing is most effective. The entire surface of the Ammoniacal Liquor is in a bubbling state of ebullition, presenting an agitated, frothy surface all over. All the Tar left in the gas after surface condensation is here completely extracted, and a large amount of Carbonic Acid.

The gas, thus so far purified, ascends from the washing chamber and passes from one superposed chamber to another in contact with the enormous amount of movable, constantly dipping wetted surfaces, leaving the uppermost chamber entirely purified from Ammonia, meeting the chemical requirements of the Board of Trade.

The Machine is self-cleansing, and can never choke or stop up; and in this important respect it is superior to all Machines heretofore known. The space occupied by the Machine is very small. In most cases it can be placed in the space inside the end of the Purifying House. Its cost is less than any other known apparatus for purifying gas from Tar and Ammonia.

These Machines are at work and in hand for Widnes, Burnley, and Oswaldtwistle, in Lancashire; at Harrogate and Wakefield, in Yorkshire; at Stalybridge, in Cheshire; at Stone, in Staffordshire; also at Cheltenham and Northampton, also at Melbourne, in Australia.

Apply, until American Agency is appointed, to

C. & W. WALKER, 8 Finsbury Circus, London.

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APPARATUS
AND
HOLDERS.

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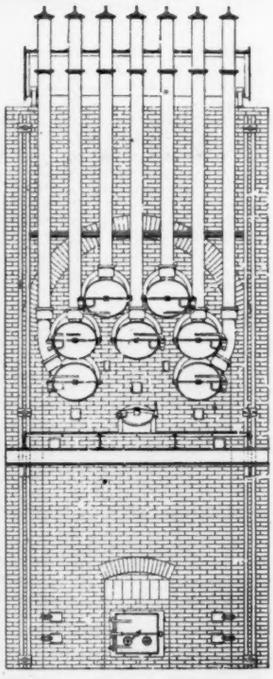

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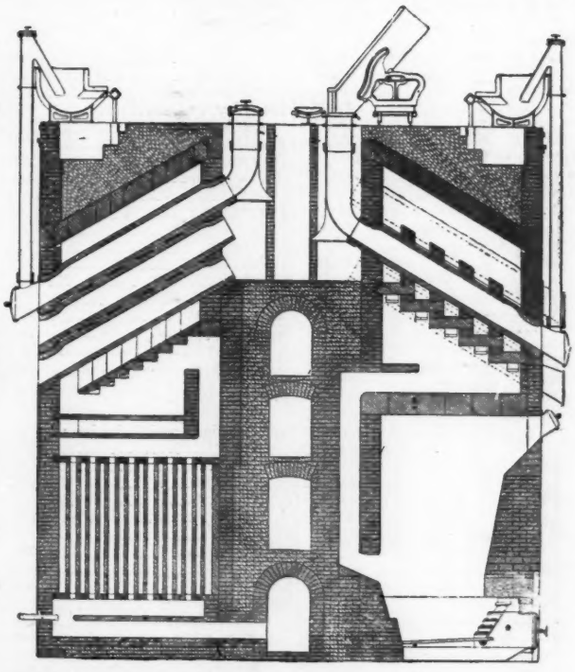
It will Save from 50 to 60 per ct. in Labor.



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KIRKHAM, HULETT & CHANDLER, LIMITED.

PATENT "STANDARD" WASHER-SCRUBBERS

Erected and in course of construction at present date:

	Capacity. Cubic feet per day.
Altrincham	600,000
Adelaide	600,000
Aldershot	200,000
Allegheny, U. S. A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co	20,000
"	20,000
Bombay	400,000
Buffalo, U.S.A., Mutual	750,000
" **Citizen**	500,000
Brookline, U.S.A.	500,000
Bergen	350,000
Berlin	1,250,000
Bournemouth	1,000,000
Bridgeport, U.S.A.	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A.	1,000,000
"	1,000,000
" **Nassau**	1,000,000
Brunner, Mond & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A.	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

	Capacity. Cubic feet per day.
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A.	350,000
Denver, "	500,000
" "	1,000,000
Dusselldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A.	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A.	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A.	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	560,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A.	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A.	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A.	750,000
Magdeburg	300,000
Memphis, U. S. A.	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A.	430,000
Newmarket	150,000
Newark, U.S.A.	680,000
Northfleet	200,000
New York, U.S.A.	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W.	100,000
Prescott	150,000
Providence, U.S.A.	750,000
"	750,000
Plauen	300,000
"	300,000
Portamouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A.	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W.	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W.	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S.A.	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A.	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A.	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A.	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A.	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A.	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A.	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A.	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A.	750,000
Yeadon	500,000
Yeovil	250,000

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Elgin National Watch Co.	Elgin, Ill.
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Decatur Gas Lt & Coke Co.	Decatur, Ill.
Niles Gas Light Co.	Niles, Mich.
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Wellington Light & Heat Co.	Wellington, Kansas.
Chippewa Falls Gas Lt. Co.	Chippewa Falls, Wis.
Elkhart Gas Lt & Coke Co.	Elkhart, Ind.
Madison City Gas Light Co.	Madison, Wis.
South Bend Gas Light Co.	South Bend, Ind.
Sheboygan National Gas Co.	Sheboygan, Wis.
Salina Gas Light Co.	Salina, Kansas.
The Rathbun Co	Deseronto, Prov. Ont.
Jefferson City Gas Lt. Co	Jefferson City, Mo.
Mankato Gas Light Co.	Mankato, Minn.
Lima Gas Light Co.	Lima, Ohio.
Minneapolis Gas Light and Coke Co.	Minneapolis, Minn.
Bellevue Water and Fuel Gas Light Co.	Bellevue, Campbell County, Ky.
Bucyrus Gas Lt. & Fuel Co.	Bucyrus, Ohio.
Morris Gas Co.	Morris, Ill.
Los Angeles Gas Co.	Los Angeles, Cal.
San Diego Gas Fuel & Electric Lt. Co.	San Diego, Cal.
Sioux Falls Gas Co.	Sioux Falls, Dak.
Dakota Gas and Fuel Co.	Grand Forks, Dak.
St. Johns Mutual Gas Co.	St. Johns, Mich.
Stillwater Gas Light Co.	Stillwater, Minn.
St. Paul Gas Light Co	St. Paul, Minn.
Emporia Electric and Gas Light Co.	Emporia, Kas.
Van Wert Gas Light Co.	Van Wert, Ohio.
Lansing Gas Light Co.	Lansing, Mich.
San Francisco Gas Lt. Co.	San Francisco, Cal.
Shelbyville Gas Light Co.	Shelbyville, Ind.
Great Falls Gas Light Co.	Great Falls, N. H.
Belleville Gas Co.	Belleville, Ontario
Rochester Lt. and Fuel Co.	Rochester, Minn.
Northwestern Gas Light and Coke Co.	Evanston, Ill.
Lincoln Gas Light Co.	Lincoln, Neb.
Davenport Gas Light Co	Davenport, Iowa.
Municipal Gas Co.	Albany, N. Y.
Alliance Gas Light Co.	Alliance, Ohio.
New Gas Light Co.	Janesville, Wis.
*Chicago Gas Light & Coke Co.	Chicago, Ill.
*Joliet Gas Co.	Joliet, Ills.
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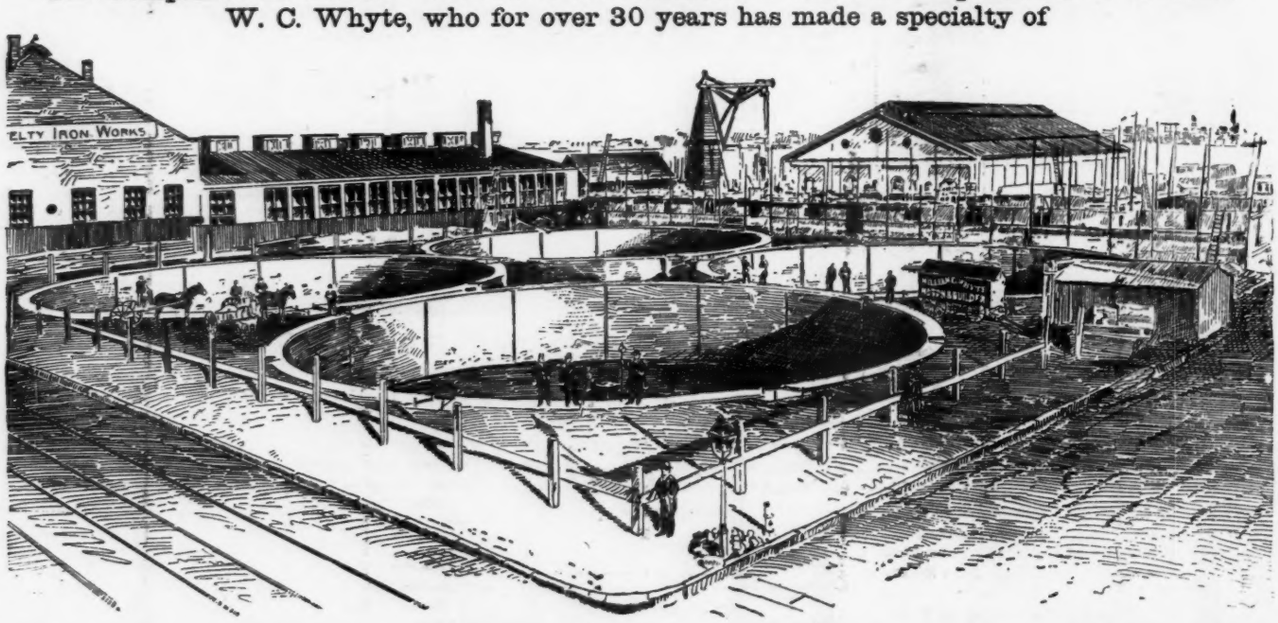

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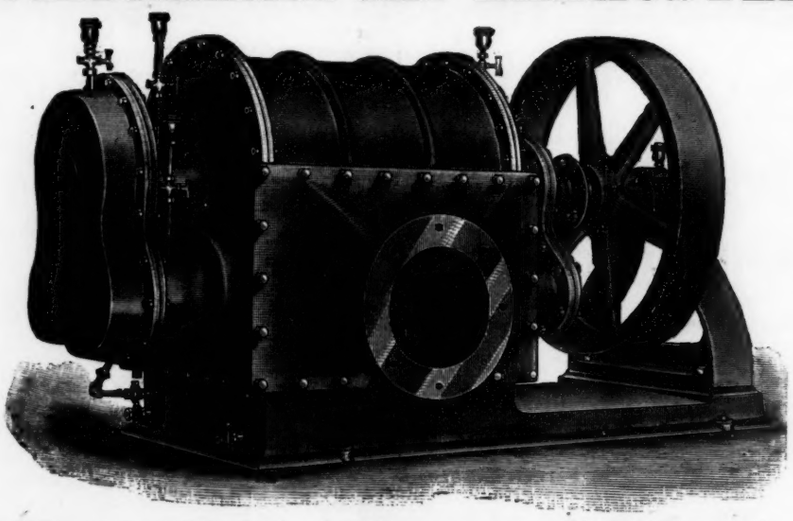

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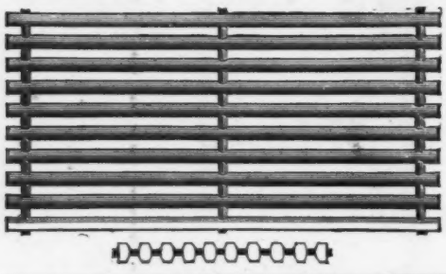

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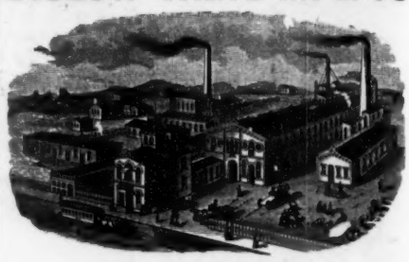

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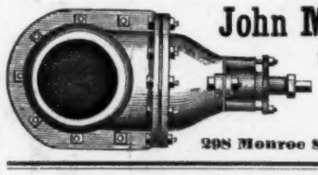

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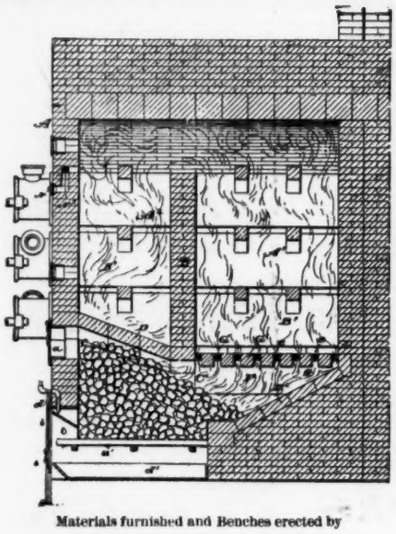

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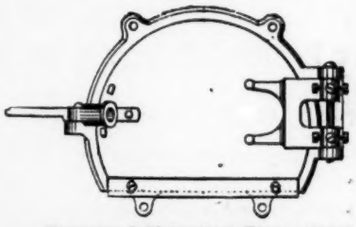

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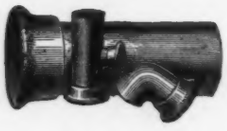

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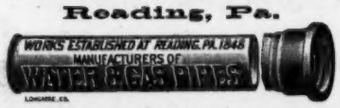

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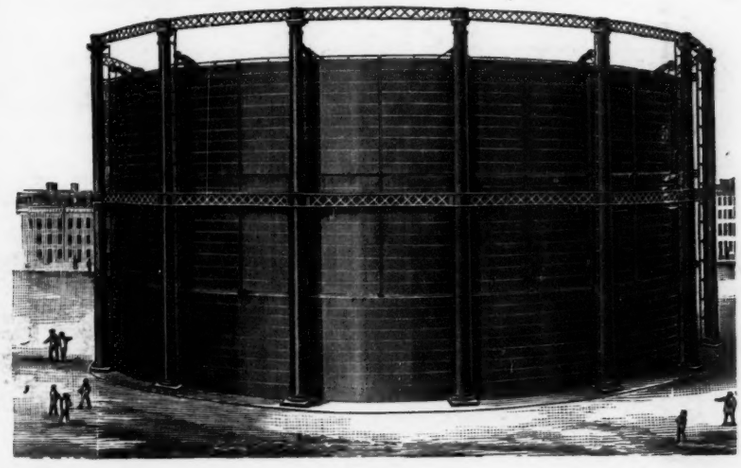

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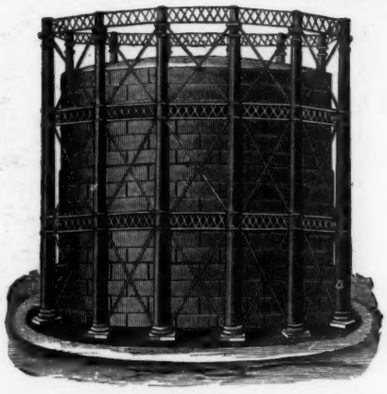

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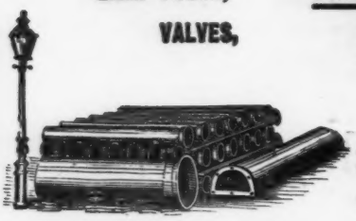

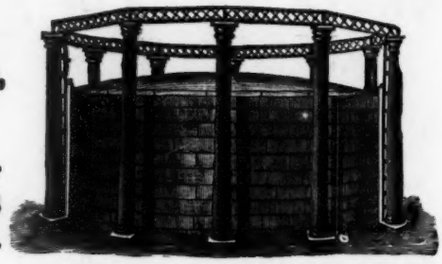

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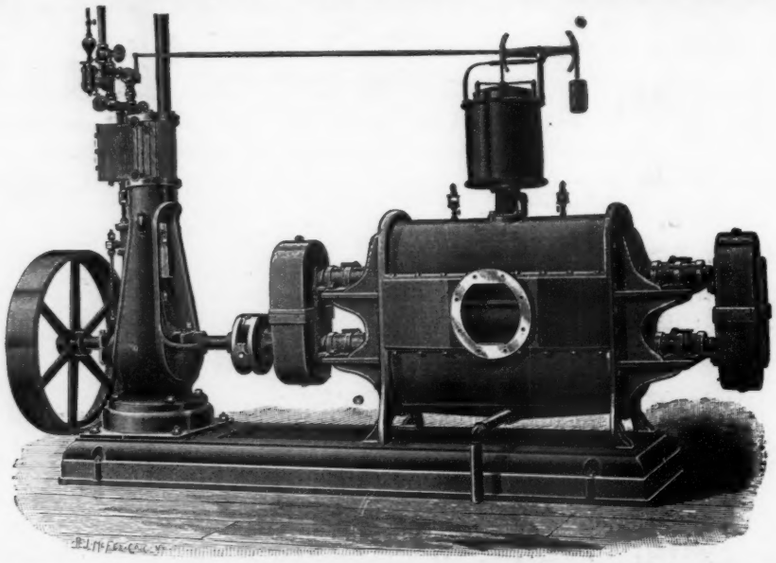

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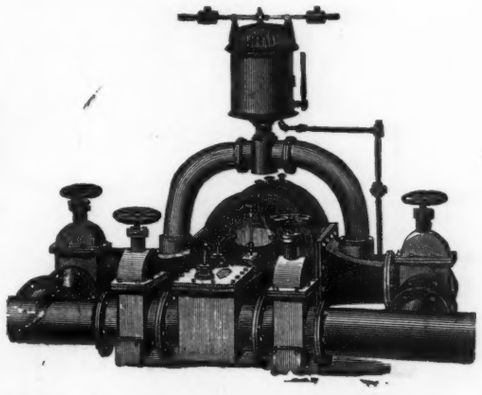

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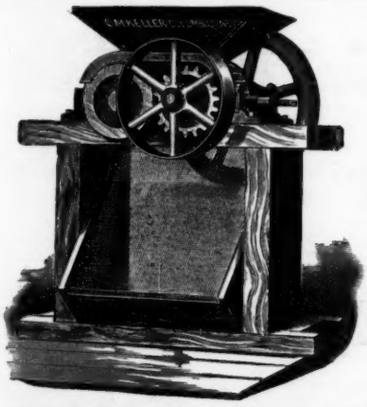

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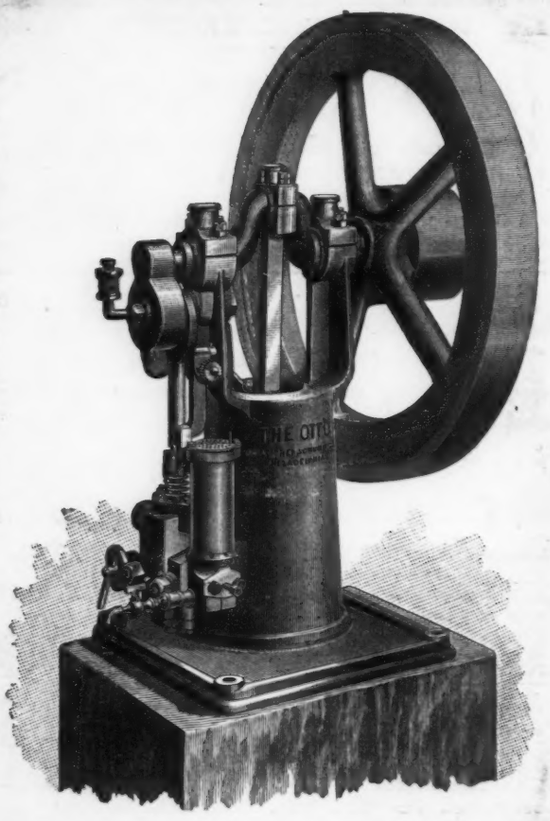

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